ROTARY WING AIRCRAFT SCIENTIFIC 
AND TECHNICAL PUBLICATIONS OF 
NASA BETWEEN 1970 AND 1982

Compiled by:

John D. Hiemstra
for the Rotorcraft Technology Office
of the National Aeronautics and
Space Administration
Washington, DC

July 1982
INTRODUCTION

This report is a bibliography of NASA documents published between 1970 and 1982 which pertain to rotary wing aircraft. The information was retrieved from the NASA RECON data base. While it is not an entirely complete listing most primary documents are cited. The entries are arranged in descending order by publication date except the NASA supported documents which are arranged in descending order by accession date.
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INTRODUCTION

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ACCESSION SERIES DEFINITIONS

All documents entered in the NASA Recon computerized library system are assigned a unique identification number. The first two numerals of this accession number identify the year that the item entered the system. The following letter denotes the particular accession series.

A. International Aerospace Abstracts (IAA). Open literature items accessioned by the American Institute of Aeronautics and Astronautics and announced in IAA.

N. Scientific and Technical Aerospace Reports (STAR). Unclassified documents of sufficient scientific/technical significance to warrant general announcement.

V. NASA Library Books (NALNET Books). This series consists of books, monographs, congressional documents, etc., designated by the participating NASA libraries for entry into the file.

TYPICAL CITATION AND ABSTRACT FROM STAR

Roger Tomboulian Washington NASA Jul-1969 48 p
(Contract NAS1-7985)
(NASA-CR-1378; GASEL-TR-713) Avail. CFSP/CSECL 01C

To fulfill the requirements for a sonic boom simulator, a
pilot facility using an air supply, a mass control valve, and a horn
for duct) was successfully constructed and operated. After an
extensive program of analysis of the end reflection conditions, a
unique solution was developed which permitted the cancellation of
the outgoing wave without the need of a large classical absorber.
The concept of this end termination is based on the fact that to
match the complex acoustical admittance present at it's end of the
duct, both the resistive and inertial components of the pressure
wave must be cancelled. The initial results obtained using this
impedance matching device on the end of the duct indicate that the
approach is conceptually sound and that a simulator device of
reasonable length can be made and yet produce full-scale sonic
boom signatures. The initial results obtained from this facility are
discussed.

Source: NASA SP-7035
Evidence is presented for the occurrence of primary processes leading to the formation of both atomic and molecular hydrogen in the photolysis of H₂O₂ at 1236 Å. Formation of OH in a primary process probably occurs as well. The latter is apparently the sole process required to explain the results at 1670 and 2537 Å. Processes leading to the formation of OH(0,0) account for less than 1% of the photochemical decomposition. Chain processes leading to the formation of O₂ but not H₂ occur at 1236 Å. The results are consistent with a free radial chain and an energy chain. It is shown that the results are more consistent with the occurrence of an energy chain involving atomic hydrogen and vibrationally excited OH radicals. Emission of OH A 2Σ⁺ - X 2Π(0,0) band at 3064 Å was observed during photolysis of H₂O₂ at 1236 and 1670 Å.

(Author)
regarding the sensitivities of individual control modes to cueing attenuation. A firmer understanding of the pilot's utilization of visual and motion cues is the key to more efficient use of simulation in helicopter control-system research.

B2N32315# ISSUE 14 PAGE 1899 CATEGORY 3 82/04/00 16 PAGES UNCLASSIFIED DOCUMENT

UTIL: Unified results of several analytical and experimental studies of helicopter handling qualities in visual terrain flight

AUTH: A/CHEN R. T. N.  
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.  
AVAIL: NTIS  
SAP: HC A11/MF A01  
In its Helicopter Handling Qualities p 59-74 (SEE N62-23209 14-03)

MINS: /AIRCRAFT SPECIFICATIONS/FLIGHT SIMULATION/GROUND BASED CONTROL/HELICOPTER CONTROL  
AAB: T.M.

ABS: The studies were undertaken to investigate the effects of rotor design parameters, interaxis coupling, and various levels of stability and control augmentation on the flying qualities of helicopters performing low-level, terrain-flying tasks in visual meteorological conditions. Some unified results are presented, and the validity and limitations of the flying-qualities data obtained are interpreted. Selected results, related to various design parameters, provide guidelines for the preliminary design of rotor systems and aircraft augmentation systems.
RELIABILITY/ AIRCRAFT, SURVIVABILITY/ ALL-WEATHER AIR NAVIGATION/ AUTOMATIC FLIGHT CONTROL/ COMBAT/ CONTROL BOARDS/ DISPLAY DEVICES/ FLIGHT CONTROL/ HELICOPTER PERFORMANCE/ RADAR NAVIGATION/ STABILITY AUGMENTATION

ANN: Helicopters are used by the military and civil communities for a variety of tasks and must be capable of operating in poor weather conditions, and at night. Accompanying extended helicopter operations is a significant increase in pilot workload and a need for better handling qualities. An overview of the status and problems in the development and specification of helicopter handling qualities criteria is presented. Topics for future research efforts by government and industry are highlighted. For individual titles, see N82-23209 through N82-23230.

B2N20188* ISSUE 11 PAGE 1465 CATEGORY 8 RPT#: NASA-TL-1996 NAS 1.60:1996 A-8719 82/03/00 50 PAGES UNCLASSIFIED DOCUMENT

UTTL: Self-tuning regulators for multicycle control of helicopter vibration

AUTH: A/JOHNSON W.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL NTIS SAP: HC 003/MF A01

MAJS: /CONTROLLERS/HELMET/SELF ADAPTIVE CONTROL SYSTEMS/VIBRATION DAMPING

MINS: /ALGORITHMS/DIGITAL SYSTEMS/FEEDBACK CONTROL, KALMAN FILTERS/LEAST SQUARES METHOD/ROTARY WINGS

ABA: M.G.

ABS: A class of algorithms for the multicycle control of helicopter vibration and loads is derived and discussed. This class is characterized by a linear, quasi-static, frequency-domain model of the helicopter response to control: identification of the helicopter model by least-squares error or Kalman filter methods; and a minimum variance or quadratic performance function controller. Previous research on such controllers is reviewed. The derivations and discussions cover the helicopter model: the identification problem, including both off-line and on-line (recursive) algorithms; the control problem, including both open-loop and closed-loop feedback; and the various regulator configurations possible within this class. Conclusions from analysis and numerical simulations of the regulators provide guidance in the design and selection of algorithms for further development, including wind tunnel and flight tests.

B2N18179-# ISSUE 8 PAGE 1175 CATEGORY 2 RPT#: NASA-TH-19122 A-88006 82/02/20 30 PAGES UNCLASSIFIED DOCUMENT

UTTL: An analytical investigation of the free-tip rotor for helicopters

AUTH: A/STROUB R.H.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL NTIS SAP: HC 003/MF A01

MAJS: /BLADE TIPS/FLIGHT CHARACTERISTICS/HELMET PERFORMANCE/HELMET/ROTARY WINGS/WING TIPS

MINS: /AERODYNAMIC CONFIGURATIONS/ AIRSPEED/ CRUISING
A rotor configuration called the free-tip rotor was analytically investigated for its potential to improve helicopter forward-flight performance characteristics. This rotor differs from a conventional rotor only in the blade tip region. In this configuration, the tip is self-adjusting in pitch with respect to the rest of the blade, in accordance with a moment balance about its pitch axis. With this self-adjusting capability, the resulting pitch motion generates a more uniform airload distribution around the azimuth. Computer math models were used to compare performance characteristics of the free tip rotor with those of a conventional rotor operation at flight speeds from 130 to 160 knots. The results of this analysis indicate that the free-tip rotor improves cruise lift-drag ratio by at least 22%.

82A17868# ISSUE 6 PAGE 806 CATEGORY 3 RPT#:
AIAA PAPER 82-0260 82/01/00 13 PAGES UNCLASSIFIED DOCUMENT

UTILT: Real-time simulation of helicopter IFR approaches into major terminal areas using RNAV, RLS, and CDI
AUTH: A/LEE, H. O.; C/PFEGH, L. L.; D/WILLETT, F. M., JR.; E/OBRIEN, P. J.; PAA: C/NASA, Ames Research Center, Moffett Field, CA; E/FAA, Technical Center, Atlantic City, NJ
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

82A1922G# ISSUE 7 PAGE 979 CATEGORY 5 RPT#:
AIAA PAPER 81-2655 61/12/00 19 PAGES UNCLASSIFIED DOCUMENT

UTILT: Analysis of selected VTOL concepts for a civil transportation mission
AUTH: A/WILSON, B. E.; C/FOSTER, J. D.; PAA: C/NASA, Ames Research Center, Moffett Field, CA
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

FLIGHT/ MATHEMATICAL MODELS/ PITCH (INCLINATION)/
MACHING MOMENTS/ ROTOR LIFT

ABA: Author

ABS: A rotor configuration called the free-tip rotor was analytically investigated for its potential to improve helicopter forward-flight performance characteristics. This rotor differs from a conventional rotor only in the blade tip region. In this configuration, the tip is self-adjusting in pitch with respect to the rest of the blade, in accordance with a moment balance about its pitch axis. With this self-adjusting capability, the resulting pitch motion generates a more uniform airload distribution around the azimuth. Computer math models were used to compare performance characteristics of the free tip rotor with those of a conventional rotor operation at flight speeds from 130 to 160 knots. The results of this analysis indicate that the free-tip rotor improves cruise lift-drag ratio by at least 22%.

82N23179# ISSUE 14 PAGE 1993 CATEGORY 34
82/01/00 5 PAGES UNCLASSIFIED DOCUMENT


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJST: /AIRCRAFT DESIGN/FIXED WINGS/FLUID DYNAMICS/GROUND EFFECT (AERODYNAMICS)/MILITARY TECHNOLOGY/V/STOL AIRCRAFT

MINS: /AIRCRAFT DESIGN/ AIRCRAFT PERFORMANCE/ PROPELLOR EFFICIENCY/ ROTORCRAFT AIRCRAFT/ SHORT TAKEOFF AIRCRAFT

ABA: E.A.K.

ABS: The impact of military applications on rotorcraft and V/STOL aircraft design with respect to fixed wing aircraft is discussed. The influence of the mission needs on the configurational design of V/STOL aircraft, the implications regarding some problems in fluid dynamics relating to propulsive flows, and their interaction with the aircraft and the ground plane, are summarized.

82A1922G# ISSUE 7 PAGE 979 CATEGORY 5 RPT#:
AIAA PAPER 81-2655 61/12/00 19 PAGES UNCLASSIFIED DOCUMENT

UTILT: Analysis of selected VTOL concepts for a civil transportation mission
AUTH: A/WILSON, B. E.; C/FOSTER, J. D.; PAA: C/NASA, Ames Research Center, Moffett Field, CA
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.


MAJST: /AIRCRAFT ENGINES/CIVIL AVIATION/ TILT ROTOR AIRCRAFT/TRANSPORT AIRCRAFT/VERTICAL TAKEOFF AIRCRAFT

MINS: /AIRCRAFT DESIGN/ COST ANALYSIS/ HELICOPTERS/ TURBOPROP ENGINES

ABA: (Author)

ABS: As part of defining the needs and technology
requirements for V/STOL aircraft research and development, the objective of this paper is to study the application of two tilt-propulsion concept V/STOL aircraft to the business/executive transport mission. The two concepts selected for study are the tilt-jet concept utilizing rotating turbofan engines for both vertical lift and cruise thrust, and the tilt-rotor concept using relatively low-disc loading propellers for hover and cruise. Overall mission costs, including the time-varying cost of the executive, were computed for a selected range of mission distances. The total trip cost was also compared to that of a conventional helicopter/business jet combination for a typical executive transport mission.

B219201* ISSUE 7 PAGE 978 CATEGORY 5 RPT#:
AIAA PAPER 81-2609 81/12/60 11 PAGES UNCLASSIFIED

UJT/.: Ground effect hover characteristics of a large-scale twin tilt-nacelle V/STOL model


MAJ/0: AERODYNAMIC CHARACTERISTICS/AIRCRAFT DESIGN/GROUND EFFECT (AERODYNAMIC)/HOVERING/ TILT ROTOR AIRCRAFT/V/STOL AIRCRAFT

MINS: /COMPUTER PROGRAMS/ FLIGHT DISTRIBUTION/ JET IMPINGEMENT/ PRESSURE DISTRIBUTION/ TILTED PROPULSERS/ WALL JETS

ABA: (Author)

ABS: This paper is a summary of an analysis of the ground-effect characteristics of a large-scale twin-engine, tilt-nacelle V/STOL model. The analysis considers data from the flow field beneath the full-scale model, as well as small-scale model test data, and makes comparisons with solutions predicted by a computer code. The data from the large-scale test comprise ground-plane surface temperatures, static pressure distribution and wall-jet total-pressure profiles, fuselage undersurface static pressures, and model forces and moments. The results indicate that the near-field flow is more complex than is indicated by either the small-scale uniform jet studies or the computer predictions. The far-field flow characteristics do show some similarity for these three cases.

B2A16914* ISSUE 5 PAGE 653 CATEGORY 4 RPT#:
AIAA PAPER 81-2654 81/12/00 13 PAGES UNCLASSIFIED

UJT/.: Helicopter manufacturing approaches with microwave landing system guidance


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Pall Alto, CA; Dec. 7-9, 1981, AIAA 13" PAGE DOCUMENT

MAJ/0: AEROSPACE GUIDANCE/APPROACH CONTROL/FLIGHT TESTS/AIRCRAFT GUIDANCE/AIRCRAFT CONTROL/MICROWAVE LANDING SYSTEMS

MINS: /AIR TRAFFIC CONTROL/ AIRSPEED/ FEASIBILITY ANALYSIS/ GLIDE LANDINGS/ GLIDE PATHS/ SPACING

ABA: (.R.

ABS: It is desirable that the landing approach of helicopters and V/STOL aircraft into a congested airport equipped with a microwave landing system (MLS) can take place essentially independent of COTL talk. The helicopter approach has been conceived as one way to provide aircraft separation while requiring minimum airspace. A helicopter descent makes it possible for the helicopter to lose altitude and maintain a controlled descent without descending so that the excessively steep glide angle. This avoids helicopter handling problems which occur at slow airspeeds. Preliminary flight-test data are presented regarding the operational feasibility of the helicopter approach under IRS conditions, where the primary guidance information is from an MLS.

B2A14392* ISSUE 3 PAGE 326 CATEGORY 5 RPT#:
AIAA PAPER 81-2386 81/11/00 9 PAGES UNCLASSIFIED

UJT/.: The use of frequency methods in rotorcraft system identification


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.


MAJ/0: AEROSPACE GUIDANCE/AIRCRAFT MODELS/FREQUENCY RESPONSE
A new approach to model structure determination is examined. Flight data from the Rotor Systems Research Aircraft (RSRA) are transformed into the frequency domain and truncated to provide band limiting. The stepwise regression technique is then used to identify a quasi-static state-space model from the transformed data. The data processing requirements for both time domain and frequency domain identification are compared and the results of the two techniques are compared.

Rotor systems research aircraft (RSRA) rotor force and moment measurement system

The two Rotor Systems Research Aircraft (RSRA) are flight vehicles with unique measurement capabilities. The principal goal of the RSRA is direct measurement of rotor forces and moments in flight. This is accomplished through a rotor force and moment measurement system comprised of load cells and/or hydro-pneumatic isolator units which are integral to the aircraft structure. Due to structural flexibility, the aircraft must undergo a physical calibration. A static calibration of the first RSRA has been completed, and data analysis has progressed through determination of a linear calibration algorithm. Design, development, and operation of the RSRA rotor force and moment measurement system and the Static Calibration Facility are described, and results of the calibration are presented.

The impact of military applications on rotorcraft and V/STOL aircraft design is summarized with respect to fixed-wing aircraft. The influence of the mission needs on the configuration design of V/STOL aircraft is discussed, and the implications regarding some problems in fluid dynamics relating to propulsion flows and their interaction with the aircraft and the ground plane, are also considered. Additional research in fluid dynamics that can contribute to an improvement in
performance of V/STOL aircraft is suggested.

B2N17224# ISSUE 8 PAGE 1030 CATEGORY 7
81/09/00 12 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/WALKER, C. L.; B/WEDEN, G. J.; C/ZUK, J. PAA:
A/Army Propulsion Lab., Cleveland, Ohio); B/Army Propulsion Lab., Cleveland, Ohio
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL.NTIS
SAP: HC A14/MF A01
In AGARD Helicopter Propulsion Systems 12 p (SEE
No2-17203 08-07)

MAJS: /COMPONENT RELIABILITY/*HELICOPTER ENGINES/*
HELICOPTER PERFORMANCE/*LIFE CYCLE COSTS/*PROPULSION
SYSTEM CONFIGURATIONS
MINS: /COST ANALYSIS/*ECONOMIC ANALYSIS/*MILITARY
TECHNOLOGY/*OPERATING COSTS/*PROPULSION EFFICIENCY

ABA: E.A.K.

ABS: The factors affecting the helicopter market for the
past, present, and future are reviewed. Acquisition
is considered. The potential for
advanced vehicle configurations with substantial
improvements in energy efficiency, operating
economics, and characteristics to satisfy the demands
of the future market are identified. Advanced
propulsion systems required to support these vehicle
configurations and the component technology for the
eengine systems are discussed. The selection of
components in areas of economics and efficiency is
considered.

B2N321724# ISSUE 3 PAGE 269 CATEGORY 2 RPT#:
61 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CARSDONNA, F. X.; B/TUNG, C.
CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif.; Army Aviation
Research and Development Command, Moffett Field,
Calif. AVAIL.NTIS SAP: HC A04/MF A01
Prepared jointly with Army Aviation Research and
Development Command. Presented at the 6th European
Rotocraft and Powered Lift Aircraft Forum, Bristol,
England, 16-19 Sep. 1990

MAJS: /BLADE TIPS/*HELICOPTER WAKES/*HOVERING/*ROTOR
AERODYNAMICS/*VORTICES
MINS: /FLOW GEOMETRY/*PREDICTION ANALYSIS TECHNIQUES/
PRESSURE DISTRIBUTION/*TRANSONIC FLOW

ABA: J.M.S.

ABS: A benchmark test to aid the development of various
rotor performance codes was conducted. Simultaneous
blade pressure measurements and tip vortex surveys
were made for a wide range of tip Mach numbers
including the transonic flow regime. The measured tip
vortex strength and geometry permit effective blade
loading predictions when used as input to a prescribed
wake lifting surce code. It is also shown that with
proper inflow and boundary layer modeling, the
supercritical flow regime can be accurately predicted.

B2N321735# ISSUE 24 PAGE 3290 CATEGORY 2 RPT#:
81/09/00 22 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/NAKAMURA, Y.
CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif.; Army Aviation
Research and Development Command, Moffett Field,
Calif. AVAIL.NTIS SAP: HC A02/MF A01
Prepared in cooperation with Army Aviation Research
and Development Command, Moffett Field, Calif.
Presented at 7th European Rotocraft and Powered Lift
Aircraft Forum

MAJS: /BLADE SLIP NOISE/*BLADE TIPS/*HELICOPTER/*NOISE
PREDICTION (AIRCRAFT)/*ROTOR AERODYNAMICS/*VORTICES

MINS: /ACOUSTIC MEASUREMENT/*LEADING EDGES/*MATHEMATICAL
MODELS/*PRESSURE DISTRIBUTION/*WAVEFORMS

ABA: Author

ABS: The impulsive nature of noise due to the interaction
of a rotor blade with a tip vortex is studied. The
time signature of this noise is calculated
theoretically based on the measured blade surface
pressure fluctuations of an operational load survey
rotor in slow descending flight and is compared with
the simultaneous microphone measurement. Particularly,
the physical understanding of the characteristics
features of the waveform is extensively studied in order
to understand the generating mechanism and to identify
the important parameters. The interaction trajectory
of a tip vortex on an acoustic pialar foil is shown to be
a very important parameter for the impulsive shape
of the noise. The unsteady nature of the pressure
distribution at the very leading edge is also
important to the pulse shape. The theoretical model
using noncompact linear acoustics predicts the general
shape of interaction impulse pretty well except for
peak amplitude which requires more continuous
information along the span at the leading edge.
A helical-approach concept is presented for Instrument Flight Rules (IFR) operation of rotorcraft into congested terminal areas where separation from high-speed jet traffic is highly desirable and the airport-precision-approach aid is a Microwave Landing System (MLS). The concept takes advantage of the fact that rotorcraft need not land on the main runway but can operate from a pad that lies on an MLS radial offset from the centerline. The results of 46 flights using a UH-60 helicopter and a research system are presented. Three levels of navigation sophistication were also investigated. It is shown that an approach helix can be obtained in a relatively small volume and that being within the Instrument Landing System (ILS) Category II window at a 30-4 (1100 ft) altitude is not a requirement for a successful hover over a landing pad. Only two of the three navigation systems provided estimates that allowed all flights to descend from hover to touchdown.

B1A4554-# ISSUE 21 PAGE 3625 CATEGORY B RPT#: AIAA PAPER 81-1855 81/08/00 15 PAGES UNCLASSIFIED DOCUMENT

UTIL: Kinematic properties of rotary-wing and fixed-wing aircraft in steady coordinated high-g turns
AUTH: A/CHEN, R. T. N.; PAA: A/INASA, Ames; Research Center, Moffett Field, CA.
CORP: National Aeronautics and Space Administration; Ames Research Center, Moffett Field, Calif.

MAJS: "ACCELERATION (PHYSICS)"/"AIRCRAFT MANEUVERS"/"CRITICAL LOADING"/"FIXED WINGS"/"KINEMATICS"/"ROTARY WING AIRCRAFT"
MINS: / AERODYNAMIC LOADS/ AIRCRAFT STABILITY/ ANGLE OF ATTACK/ CONTROLABILITY/ FLIGHT CHARACTERISTICS/ FLIGHT MECHANICS/ HELICOPTER CONTROL

ABA: J.F.

An analytical approach to the study of flight dynamics of aircraft operating in a high-angle-of-attack flight regime and of helicopters operating in extreme flight conditions is presented. Steady coordinated high-g turns are used to establish the initial equilibrium flight conditions near stall angles of attack. The kinematic properties of the aircraft and helicopter are examined: in high-g turns, pitch rate (independent of the angle of attack) is of a much larger magnitude than roll and yaw rate; a substantial roll rate is found to develop in steep turns for all...
angles of attack; the angle of attack also has a
significant effect on the pitch attitude, with
decreasing influence as the normal load factor
increases. The exact small disturbance equations of
motion of the aircraft in general steady turns are
also developed for application to both rotary-wing and
fixed-wing aircraft in extreme conditions.
These equations are in a first-order, vector-matrix format,
and are thus compatible with the many efficient software
packages developed in modern system theory.

CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif. AVAL NII
SAP: HC 1A/3 MF ADI
MAJS: \( + \) AERODYNAMIC CHARACTERISTICS/+ BEARINGLESS ROTORS/ +
ROTOR WINGS

MINs: \( / \) AERODECASTIC/ HELICOPTERS/ LOADS (FORCES)/ ROTOR
AERODYNAMICS/ WIND TUNNEL TESTS

ABA: R. C.

ABS: A helicopter bearingless main rotor was tested. Areas
of investigation included aerelastic stability,
aerodynamic performance, and rotor loads as a function
of collective pitch setting, RPM, airspeed and shaft
angle. The rotor/support system was tested with the
wind tunnel balance dampers installed and subsequently,
removed. Modifications to the rotor hub
were tested. These included a reduction in the rotor
control system stiffness and increased flexbeam
structural damping. The primary objective of the test
was to determine aerelastic stability of the
fundamental flexbeam/blade chordwise bending mode. The
rotor was stable for all conditions. Damping of the
rotor chordwise bending mode increases with increased
collective pitch angle at constant operating
conditions. No significant decrease in rotor damping
occurred due to frequency coalescence between the blade
chordwise fundamental bending mode and the support
system.

ORB: National Aeronautics and Space Administration, Ames
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chordwise fundamental bending mode and the support
system.

ORB: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif. AVAL NII
SAP: HC 1A/3 MF ADI
MAJS: \( + \) AERODYNAMIC CHARACTERISTICS/+ BEARINGLESS ROTORS/ +
ROTOR WINGS

MINs: \( / \) AERODECASTIC/ HELICOPTERS/ LOADS (FORCES)/ ROTOR
AERODYNAMICS/ WIND TUNNEL TESTS

ABA: R. C.
of modeling complex rotorcraft for realtime simulation and because of the need for a wide-angle visual system for low-level flight. A joint U.S. Army and NASA program was initiated to provide this simulation capability for exploitation by both government and industry. The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is discussed.

B1A236568# ISSUE 17 PAGE 2089 CATEGORY 7
B1/05/00 14 PAGES UNCLASSIFIED DOCUMENT

UTIL: Component research for future propulsion systems

AUTH: A/WALKER, C. L.; B/WEDEK, G. J.; C/ZUK, J. PAA;
B/US Army, Propulsion Laboratory, Cleveland, OH;
C/INASA, Ames Research Center, Moffett Field, CA

CORP: Army Propulsion Lab., Cleveland, Ohio.; National
Aeronautics and Space Administration, Ames Research
Center, Moffett Field, Calif.

NATO, AGARD, Specialists' Meeting, 57th, Toulouse,

MAJS: /AIRCRAFT ENGINES/AIRCRAFT RELIABILITY/ENERGY
CONVERSION EFFICIENCY/HELICOPTER DESIGN/LIFE CYCLE
COSTS/PROPULSION SYSTEM PERFORMANCE

MINS: /AIRCRAFT MAINTENANCE/AIRCRAFT PARTS/ENGINE DESIGN/
ENGINE PARTS/ FUEL CONSUMPTION/TECHNOLOGICAL
FORECASTING/TURBOCOMPRESSORS

ABA: E.B.

ABS: A review of factors related to the acquisition and
life-cycle cost, and mission reliability of
helicopters is given. The potential for advanced
vehicle configurations with improvements in energy
efficiency, operating economics, and characteristics
to satisfy the demands of the future market are
identified. Special attention is given to advanced
propulsion systems and related component technologies,
and system requirements, powerplants and component
thrusts, compressor designs, combustion systems,
turbine efficiency, blade tip treatment concepts and
shaft dynamics are discussed in detail.

B1A42749# ISSUE 20 PAGE 3453 CATEGORY 4: RPT:
SAA PAPER B105B9 01/04/00 18 PAGES UNCLASSIFIED DOCUMENT

UTIL: Rotorcraft researchers and operators - Is there a
common ground

Research Center, Aeronautical Systems Branch, Moffett
Field, CA)

CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif.

Society of Automotive Engineers, Business Aircraft
Meeting and Exposition, Wichita, KS. Apr. 7-10, 1981.
18 p.

MAJS: /HELICOPTER DESIGN/NASA PROGRAMS/OPERATIONAL
PROBLEMS/HELICOPTER AIRCRAFT

MINS: / AIRCRAFT PARTS/AVIONICS/CIVIL AVIATION/HELICOPTER
ENGINES/PROPULSION SYSTEM PERFORMANCE

ABA: G.R.

ABS: Investigation is conducted concerning the extent to
which a program for rotorcraft research presented by
NASA meets the user needs. Problems of civil operators
are examined, taking into account powerplants,
reliability and maintainability, environment, noise
and vibration, and load of space for passengers'
bags. A description of applicable technology is
provided, giving attention to aerodynamics and
structures, propulsion, power transfer, flight
control, avionics systems, human factors, and
vehicle configurations. One of the most difficult
challenges in trying to bring research to bear on
operator problems is in seeking solutions that in
general researchers are working on long-term solutions
while operators are seeking short-term answers. Attention is also given to
potential technological bright spots, higher risk
technologies, highest technological risks, and
advanced vehicle configurations.

B1N27061# ISSUE 18 PAGE 2128 CATEGORY 3: RPT:
NAPA-IM-81301 A-8606 01/04/00 55 PAGES
UNCLASSIFIED DOCUMENT

UTIL: ATC Simulation of helicopter IFR approaches into major
terminal areas using RNAV, MLS, and CDI

D/WILLET, F. M., JR.; E/DOBRIEN, P. J. PAA: D/(FAA,
Atlantic City); E/(FAA, Atlantic City)

CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif. AVAIL NTIS
SAP: HC 04/0/0 A01

MAJS: / AIR TRAFFIC CONTROL/ APPROACH INDICATORS/AREA
NAVIGATION/FLIGHT SIMULATION/HELICOPTERS/MICROWAVE
LANDING SYSTEMS

MINS: / AIRCRAFT APPROACH SPACEING/ APPROACH CONTROL/
INSTRUMENT APPROACH/INSTRUMENT FLIGHT RULES

ABA: Author

ABS: The introduction of independent helicopter IFR routes
at hub airports was investigated in a real time air
traffic control system simulation involving a piloted
helicopter simulator, computer generated air
traffic, and air traffic controllers. The helicopter simulator
was equipped to fly area navigation (RNAV) routes
microwave landing system approaches. Problems studied
included: (1) pilot acceptance of the approach
procedure and tracking accuracy; (2) ATC procedures
for handling a mix of helicopter and fixed wing
traffic, and (3) utility of the cockpit display of traffic information (CDTI) for the helicopter in the hub airport environment. Results indicate that the helicopter routes were acceptable to the subject pilots and noninterfering with fixed wing traffic. Merging and spacing maneuvers using CDTI were successfully carried out by the pilots, but controllers had some reservations concerning the acceptability of the CDTI procedures.

BIN20066: * ISSUE 11 PAGE 1438 CATEGORY 5 RPT: NASA-TR-81201 A-B512 01/03/00 13 PAGES UNCLASSIFIED DOCUMENT

UTIL: Recent progress in V/STOL aircraft technology
TISP: Fini I Report
AUTH: A.ROBERTS, L.; B.DECKERT, W.; C.HICKEY, D.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL NTIS
SAP: HC A02/MF A01
MAJS: /FLIGHT TESTS/RESEARCH AIRCRAFT/SHORT HAUL AIRCRAFT/TILT ROTOR AIRCRAFT/TURBOFAN AIRCRAFT/V/STOL
MINS: /NACELLES/QUIET ENGINE PROGRAM/UPPER SURFACE BLOWN FLAPS
ABA: Author
ABS: Results from wind tunnel and flight tests investigations for V/STOL aircraft are reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft; and a turboshaft V/STOL aircraft. Comparison and correlation between theoretical and experimental results and between wind tunnel and flight test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Technology (QSTA) program. The QSTA aircraft uses an upper surface blown flap and develops an engine-out landing approach lift coefficient of 5.5 and landing distances less than 1,000 ft. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Bell XV-15 TRRA aircraft flight investigations. The TRRA is a twin rotor research aircraft capable of vertical takeoff and landing and cruise speeds of 300 knots. The turboshaft V/STOL aircraft technology results are from static ground facility and wind tunnel investigations of a NASA/Navy/Grumman full scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines.

BIN19101: * ISSUE 10 PAGE 1503 CATEGORY 5 RPT: NASA-TR-81276 USAAVRADCOM-TR-B1-A-7 01/03/00 25 PAGES UNCLASSIFIED DOCUMENT

UTIL: The role of the research simulator in the systems development of rotocraft
AUTH: A.STATLER, L. C.; B.DEEL, A.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Aviation Research and Development Command, Moffett Field, Calif. AVAIL NTIS
SAP: HC A02/MF A01
MAJS: /COMPUTERIZED SIMULATION/FLIGHT SIMULATION/FLIGHT
The potential application of the research simulator to future rotorcraft systems design, development, preproduction evaluation, and safety analysis is examined. Current simulation capabilities for fixed-wing aircraft are reviewed and the requirements of a rotorcraft simulator are defined. The visual system components, vertical motion simulator, cab, and computational system for a research simulator under development are described.

The acoustic characteristics of circulation-controlled rotors are examined by comparing data from three full-scale rotors: a conventional rotor, the X-Wing rotor, and the Circulation Control Rotor. Both the X-Wing rotor and Circulation Control Rotor had higher sound levels than the conventional rotor at identical advancing-tip Mach numbers. There is excess noise due to the compressor on the X-Wing rotor and excess broadband noise on the Circulation Control Rotor. The X-Wing rotor had lower sound levels than the conventional rotor at identical forward speeds because of the lower tip speed feasible with the use of circulation control.

The development of a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. Particular emphasis is given to describing the reasons...
behind the choices and decisions involved in constructing the model. The analysis is designed to calculate the rotor performance of the backup control system engagement for the YAH-64


CORP: Army Research and Technology Labs., Moffett Field, Calif.; National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJS: /"YAH-64 HELICOPTER/"AIRCRAFT PILOTS/"BACKUP/"CONTROL SIMULATION/"HELICOPTER CONTROL/"OPTIMUM CONTROL

INS: /AUTOMATION FLIGHT CONTROL/ CONTROL EQUIPMENT/ FEEDBACK CONTROL/ FLIGHT TESTS/ PILOT TRAINING

ABA: (Author)

ABS: A piloted simulator experiment, designed to evaluate and optimize certain backup control system (BCS) engagement parameters and to provide pilot familiarization with aircraft response prior to flight testing. BCS is defined as a control system which, in its normal operation, is used to control the aircraft. In the event of a failure of the primary control system, the BCS is activated to provide backup control to the aircraft. The simulation was developed to represent the control system of a YAH-64 Attack Helicopter. The simulation modeled the dynamic behavior of the aircraft, including the effects of control inputs. The simulation was designed to provide pilots with a realistic representation of the aircraft's response to various control inputs.

FAILING PAGE: OF POOR QUALITY

B1A46464# ISSUE 22 PAGE 3817 CATEGORY B
81/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Influence of sideslip on the kinematics of the helicopter in steady coordinated turns

AUTH: A/CHEN, R. T. N.; B/JESKE, J. A. PAA: B/(NASA, Ames Research Center, Moffett Field, Calif.)

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.


A flight experiment was conducted using the NASA-Army V/Stolang UH-1H variable-stability helicopter to investigate the influence of several longitudinal-static stability, control augmentation, and flight-director parameters on helicopter flying qualities during terminal area operations in instrument conditions. This experiment, which was part of a joint NASA/FAA program pertaining to helicopter IFR airworthiness, was designed to corroborate and extend previous ground simulation results obtained in this program. Variations examined included stable and neutral longitudinal control position gradients, rate-chopping and altitude-command augmentation, and raw data versus flight-director displays. Pilot rating results agreed excellently with the ground simulation data, indicating an adequate instrument capability with rate-chopping augmentation and neutral statics and the need for pitch-roll attitude augmentation to achieve a satisfactory system.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Federal Aviation Administration, Moffett Field, Calif.; Army Research and Technology Labs., Moffett Field, Calif.

MAJS: Flight simulation, flight control, helicopter control, instrument flight rules, static stability

MINS: Aircraft equipment, augmentation, flight mechanics, flight simulation, flight tests, longitudinal control


PAA: B/NASA, Ames Research Center, Moffett Field, CA; C/FAA, Moffett Field, CA; D/U.S. Army, Aeromechanics Laboratory, Moffett Field, CA

UTIL: Investigation of control, display, and crew loading for helicopter instrument approach.

PUB: AIAA 81-1820 81/00/00 15 PAGES UNCLASSIFIED DOCUMENT

ISSUE: 21 PAGES 3624 CATEGORY B RPT: BIAAA

TERM: 20 PAGE 13 (ITEMS 38 – 39 OF 170)
augmentation were examined with display variations consisting of raw elevation and azimuth data only and of raw data plus one-, two-, and three-axes flight directors. Crew loading situations simulated for the control-display combinations were dual-pilot operation and single-pilot operation. Four pilots performed a total of 150 evaluations of combinations of these parameters for a representative microwave landing system approach task. Pilot rating results indicated the existence of a control display trade-off for ratings of satisfactory, whereas ratings of adequate-but-unsatisfactory depended primarily on the control system configuration. The control system configuration was clearly more complex for the single-pilot situation than that for the dual-pilot situation.

B1N2055* ISSUE 13 PAGE 1719 CATEGORY 7 RPT: NASA-TM-82613 ARVADCOM-TR-81-C-12 81/00/00 16 PAGES UNCLASSIFIED DOCUMENT

UTLTL: Development of a comprehensive analysis for rotorcraft. I - Rotor model and wake analysis


MAYS: /AIRCRAFT DESIGN/AIRCRAFT WAKES/ROTARY WINGS/ROTORCRAFT AIRCRAFT

AINS: /AERODYNAMIC CHARACTERISTICS/AEROSTABILITY/AERODYNAMIC NOISE/AIRCRAFT PERFORMANCE/DESIGN ANALYSIS/GUST LOADS/MATHMATICAL MODELS/PREDICTION/VIBRATION EFFECTS

ABA: (Author)

ABS: The development of a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. Particular emphasis is given to describing the reasons behind the choices and decisions involved in constructing the model. The analysis is designed to calculate rotor performance, loads, and noise; helicopter vibration and gust response; flight dynamics and handling qualities; and system aerostability. It is intended for use in the design, testing, and evaluation of a wide class of rotors and rotorcraft, and to be the basis for further development of rotary-wing theories. The general characteristics of the geometric, structural, inertial, and aerodynamic models used for the rotorcraft components are described, including the assumptions introduced by the chosen models and the resulting capabilities and limitations. Finally, some examples from recent applications of the analysis are given.

B1N2450* ISSUE 11 PAGE 704 CATEGORY 5 80/10/00 9 PAGES UNCLASSIFIED DOCUMENT

UTLTL: Evaluation of the effect of elastomeric damping material on the stability of a bearingless main rotor system


MAYS: /BEARINGLESS ROTORS/ELASTIC DAMPING/ELASTOMERS/ROTARY WINGS/SYSTEMS STABILITY/VIBRATION DAMPING
The considered Investigation was conducted in connection with a contract to design, fabricate, and test a prototype bearingless main rotor (BMR) system. Part of the design process involved an aerelastic stability investigation in a wind tunnel. Attention is given to a description of model testing, model test results, the description of the full scale wind tunnel configuration, full scale test results, and aspects of correlation with theory. It was found that the complex geometry of the BMR, with 12.5 degrees of nose-up prepitch at the hub and 2.5 degrees of tip-up predeform at the blade attachment clevis, is required to achieve a stable configuration. Subsequent model testing showed that a constrained layer of elastomer material could increase stability at all rotor speeds and collectives tested for a flat strap configuration.

MINS: /AEREOELASTICITY/ CHORDS (GEOMETRY)/ DIMENSIONS/ FULL SCALE TESTS/ HELICOPTER DESIGN/ PITCH (INCLINATION)/ PROTOTYPES/ ROTOR AERODYNAMICS/ SCALE MODELS/ SYSTEMS ENGINEERING/ WIND TUNNEL TESTS

ABA: G.R.

ABS: The considered Investigation was conducted in connection with a contract to design, fabricate, and test a prototype bearingless main rotor (BMR) system. Part of the design process involved an aerelastic stability investigation in a wind tunnel. Attention is given to a description of model testing, model test results, the description of the full scale wind tunnel configuration, full scale test results, and aspects of correlation with theory. It was found that the complex geometry of the BMR, with 12.5 degrees of nose-up prepitch at the hub and 2.5 degrees of tip-up predeform at the blade attachment clevis, is required to achieve a stable configuration. Subsequent model testing showed that a constrained layer of elastomer material could increase stability at all rotor speeds and collectives tested for a flat strap configuration.

8142010* ISSUE 13 PAGE 2107 CATEGORY 5 80/10/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Use of multiblade sensors on on-line rotor tip-path plane estimation


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJS: /FLAPPING/*HELIICOPTER CONTROL/*ROTARY WINGS/*ROTOR AERODYNAMICS/*ROTOR BLADES/*TIP SPEED

MINS: /BLADE TIPS/ COMPUTERIZED SIMULATION/ ERROR ANALYSIS/ FILTRATION/ MATRICES (MATHEMATICS)/ NUMERICAL ANALYSIS /PITCH (INCLINATION)/ SENSORS/ TRANSIENT RESPONSE

ABA: (Author)

ABS: The results of a study conducted to investigate further a means of choosing primary rotor parameters to reduce the coupling of longitudinal and lateral flapping in hover and in forward flight are presented. The rotor parameters included flapping hinge offset, flapping hinge restraint, pitch-flap coupling, and blade lock number are known to influence the agility, stability, and operational safety of helicopters. Effects of the nonlinear downwash model of White and Blake on the blade flapping motion are examined, and the theoretical calculation is then correlated with experimental test data. The condition for achieving perfect decoupling of the flapping response due to aircraft pitch and roll rates, which was previously obtained for a hovering rotor, is evaluated in forward flight. The results show that negligible coupling is achieved in forward flight; moreover, there is the additional benefit of a slight reduction in the coupling of the roll rate to coning. It is also indicated that the values of the rotor parameters chosen according to the decoupling condition are moderate and that the flapping motion is stable with the parameters chosen.

B1N33356* ISSUE 24 PAGE 3227 CATEGORY 2 RPT#: NASA-TI-1721 A-8023 80/10/00 32 PAGES UNCLASSIFIED DOCUMENT

UTTL: Calculation of three-dimensional unsteady transonic flows past helicopter blades

AUTH: A/CHATTO, J. J.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.: Army Aviation Research and Development Command, Moffett Field, Calif.

MAJS: /FINITE DIFFERENCE THEORY/*HELIICOPTER DESIGN/*
NUMERICAL ANALYSIS/ROTOR AERODYNAMICS/TRANSONIC FLOW
MINS: /ALGORITHMS/ COMPUTER PROGRAMMING/ COMPUTERIZED DESIGN/ DIFFERENCE EQUATIONS
ABA: Author
ABS: A finite difference code for predicting the high speed flow over the advancing helicopter rotor is presented. The code solves the low frequency, transonic small disturbance equation and is suitable for modeling the effects of advancing blade unsteadiness on blades of nearly arbitrary planform. The method employs a quasi-conservative mixed differencing scheme and solves the resulting difference equations by an alternating direction scheme. Computed results showed good agreement with experimental blade pressure data and illustrate some of the effects of varying the rotor planform. The flow unsteadiness is shown to be an indispensable part of a transonic solution. Close to the tip at high advance ratio, cross flow effects can significantly affect the solution.

8110077# ISSUE 1 PAGE 12 CATEGORY B RPT#: NASA-TM-81180 FAA-RD-80-04 A-8125 80/09/00 393 PAGES UNCLASSIFIED DOCUMENT
UTTL: A piloted simulator investigation of static stability and stability/control augmentation effects on helicopter handling qualities for instrument approach
AUTH: A/LEBACQ, J. V.; B/FOREST, R. D.; C/GERDES, R. M.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAL.NTIS SAP: HC 417/MAF A01
MAJS: /AIRCRAFT RELIABILITY/FLIGHT SIMULATION/INSTRUMENT APPROACH/PITCHING MOMENTS/ROLLING MOMENTS/ROTARY WING AIRCRAFT/YAWING MOMENTS
MINS: /AERODYNAMIC COEFFICIENTS/HELICOPTERS STABILITY DERIVATIVES
ABA: S.F.
ABS: A motion base simulator was used to compare the flying qualities of three generic single rotor helicopters during a full attention to flight control task. Terminal area instrument approaches were flown with and without turbulence. The turbulence of helicopter static stability was investigated in terms of the values of cockpit control gradients as specified in the existing airworthiness criteria. The effectiveness of several types of stability control augmentation systems in improving the instrument flight rules capability of helicopters with reduced static stability was examined. Two levels of static stability in the pitch, roll, and yaw axes were examined for a hingeless rotor configuration; the variations were stable and neutral static stability in pitch and roll, and two levels of stability in yaw. For the lower level of static stability, four types of stability and control augmentation were examined for helicopters with three rotor types: hingeless, articulated, and teetering.

8210030# ISSUE 1 PAGE 5 CATEGORY 5 RPT#: NASA-TM-81218 A-8278 80/08/00 372 PAGES UNCLASSIFIED DOCUMENT
UTTL: An investigation of a stoppable helicopter rotor with circulation control -- Ames 40 by 80 foot wind tunnel
AUTH: A/BALLARD, J. D.; B/MCCLOUD, J. L.; C/FORSYTH, T. J.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAL.NTIS SAP: HC A16/MAF A01
MAJS: /AIRCRAFT RELIABILITY/CIRCULATION CONTROL ROVERS/HELICOPTER DESIGN/LIFT AUGMENTATION/X WING ROTORS
MINS: /TABLES (DATA)/WIND TUNNEL TESTS
ABA: J.M.S.
ABS: A stoppable helicopter rotor with circulation control was investigated in the Ames 40 by 80 foot wind tunnel. The model was tested as a rotating wing, a fixed wing, and during transition start/stop sequences. The capability of the model's control system to maintain pitch and roll moment balance during the start/stop sequence, the ability of the blades to withstand the start/stop loads, the accuracy of the control system to maintain balance in the helicopter mode, and the control system capabilities in the fixed-wing mode were assessed. Time-history data of several start/stop sequences of the X-wing rotor, and the steady-state data relating to the model as both a rotor and as a fixed-wing aircraft are presented. In addition, stability data are presented which were acquired during open-loop and closed-loop tests of the hub moment feedback control system.

8013407# ISSUE 2 PAGE 2955 CATEGORY B RPT#: NASA-TM-81190 A-8158 80/09/06 98 PAGES UNCLASSIFIED DOCUMENT
UTTL: Effects of rotor parameter variations on handling qualities of augmented helicopters in simulated terrain flight
AUTH: A/TALBOT, P. D.; B/DUGAN, D. D.; C/CHEN, R. T. N.; D/GERDES, R. M.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAL.NTIS SAP: HC 459/MAF A01
MAJS: /FLIGHT SIMULATION/HELICOPTER CONTROL/ROTORS
MINS: /MAKESURABILITY/PERFORMANCE TESTS
ABA: Author
ABS: A coordinated analysis and ground simulator experiment was performed to investigate the effects on single
rotor helicopter handling qualities of systematic variations in the main rotor hinge restraint, hub hinge offset, pitch-flap coupling, and blade lock number. Teetering rotor, articulated rotor, and hingeless rotor helicopters were evaluated by research pilots in 'real' low level flying tasks involving obstacle avoidance at 60 to 100 knots airspeed. The results of the experiment are in the form of pilot ratings, pilot commentary, and some objective performance measures. Criteria for damping and sensitivity are reexamined when combined with the additional factors of cross coupling due to pitch and roll rates, pitch coupling with collective pitch, and longitudinal static stability. Ratings obtained with and without motion are compared. Acceptable flying qualities were obtained within each rotor type by suitable adjustment of the hub parameters, however, pure teetering rotors were found to lack control power for the tasks. A limit for the coupling parameter L sub q/L sub p of 0.35 is suggested.

BON33349# ISSUE 24 PAGE 3226 CATEGORY 2 RPT#: NASA TM-81213 A/V/ADCOM TR-00-A-11 A-8239 80/07/00 27 PAGES UNCLASSIFIED DOCUMENT
UTTL: Comparison of calculated and measured helicopter rotor lateral flapping angles
AUTH: A. JOHNSON, W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AERONAUTICS AND SPACE SCIENCE COMMAND
ST. LOUIS, MO.
AVA.HTIS
SAP: HC 003/04 AGI
Prepared in cooperation with Army Aviation Research and Development Command, St. Louis, Mo.
MAJS: FLAPPING/HELICOPTER PERFORMANCE/ROTARY WINGS
MINS: AIRCRAFT WAKES/ GLIDING/ WIND TUNNEL TESTS
ABS: Author

BON28371# ISSUE 19 PAGE 2198 CATEGORY 5 RPT#: NASA TM-81217 A/B/263 80/07/06 20 PAGES UNCLASSIFIED DOCUMENT
UTTL: A mathematical representation of an advanced helicopter for piloted simulator investigations of control system and display variations
AUTH: A. AIKEN, E. W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVA.HTIS
SAP: HC 004/04 AGI
MAJS: DISPLAY DEVICES/HELICOPTER CONTROL/HELICOPTERS/MATHEMATICAL MODELS
MINS: COMPUTERIZED SIMULATION/ CONTROLLABILITY/ HELICOPTER DESIGN/ HELICOPTER PERFORMANCE
ABS: L. F. M.

OF POOR QUALITY

BON28341# ISSUE 19 PAGE 2320 CATEGORY 5 RPT#: NASA TM-81217 A/B/263 80/07/06 20 PAGES UNCLASSIFIED DOCUMENT
UTTL: A pilot's assessment of helicopter handling-quality factors common to both agility and instrument flying tasks
AUTH: A. GERDES, R. W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVA.HTIS
SAP: HC 002/04 AGI
MAJS: ATTITUDE CONTROL/FLIGHT SIMULATION/HELIICOPTER CONTROL/HELICOPTERS/NAF-OF-THE-EARTH NAVIGATION
MINS: AIRCRAFT CONTROL/ AUGMENTATION/ CONTROLLABILITY/ HELICOPTER PERFORMANCE/ INSTRUMENT FLIGHT RULES/ MANEUVERABILITY
ABS: L. F. M.
ABS: A series of simulation and flight investigations were
undertaken to evaluate helicopter flying qualities and the effects of control system augmentation for
nap-of-the-earth (NGE) agility and instrument flying
tasks. Handling quality factors common to both tasks
were identified. Precise attitude control was
determined to be a key requirement for successful
accomplishment of both tasks. Factors that degraded
attitude controllability were improper levels of
control sensitivity and damping, and rotor system
cross coupling due to helicopter angular rate and
collective pitch input. Application of rate command,
attitude command, and control input decouple
augmentation schemes enhanced attitude control and
significantly improved handling qualities for both
tasks. The NGE agility and instrument flying handling
quality considerations, pilot rating philosophy, and
supplemental flight evaluations are also discussed.

MAUS: /AIRCRAFT PILOT/S-ANGULAR ACCELERATION/FIGHT SIMULATORS/ROTATION/THRESHOLDS (PERCEPTION)/
VIBRATION/EFFECTS
MINS: /ACCELERATION STRESSES (PHYSIOLOGY)/ ANALYSIS OF
VARIANCE/CARDIOVASCULAR/HELICOPTERS/VERTICAL MOTION
SIMULATORS/VISUAL PERCEPTION

ABS: The effects of vibratory angular acceleration on
detection thresholds for constant angular acceleration
in a dynamic flight simulator are reported in three
experiments. Detection thresholds were determined for
10 pilots and four nonpilots using a random
double-staircase procedure while the subjects sat
erect in a device which rotated about an
earth-vertical axis. Constant angular acceleration
were presented for 0.5 and 1.0 s with concurrent
vibratory angular acceleration at 1 and 5 Hz, and
thresholds with no vibratory angular acceleration were
established. The thresholds were obtained while the
subjects observed a visual reference in the enclosed
cockpit in two experiments and in total darkness in a
third. The results confirmed earlier experiments
showing no inverse relationship between the duration of
constant angular acceleration and detection
threshold and showed that the detection thresholds in
darkness were higher than with a visual reference
present. Two analyses of variance revealed no
significant differences in thresholds across the three
vibration conditions. These results indicate that
vibratory angular acceleration at fairly high levels
can be present in a dynamic flight simulator without
masking the pilot's ability to detect either maneuver
or disturbance motions.

MAUS: /AERODYNAMIC LOADS/AIRCRAFT NOISE/COMPUTER PROGRAMS
THE FUTURE OF SHORT-HAUL TRANSPORT AIRCRAFT


CORP: National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.


MAJST: "THE FUTURE OF SHORT-HAUL TRANSPORT AIRCRAFT"

MINS: / AIR TRANSPORTATION, AIRCRAFT DESIGN, AIRCRAFT Fuels, COST REDUCTION, ECONOMIC FACTORS, HELICOPTERS, REGULATIONS, TURBOPROP AIRCRAFT

AB: 9.1

ABS: Existing economic and regulatory changes and escalating fuel costs, major airlines have begun to shift their short-haul services to smaller, more profitable routes, leaving short-haul operations to rapidly growing commuter airlines. The short-haul routes are currently serviced by small turboprop-powered aircraft. The results of some recent design studies aimed at replacing the turboprops with specialized propulsion and rotor-driven aircraft are discussed. Some recent future designs are illustrated and discussed.

The XV-15 aircraft was tested at the Ames 40 by 80 Foot Wind Tunnel for preliminary evaluation of aerodynamic and aeroelastic characteristics prior to flight. The tests were undertaken to investigate the aircraft performance, stability, control and structural loads for flight modes from helicopter.
through transition and airplane mode up to the tunnel capability of 170 knots. Results from these tests are presented.

BON1702347# ISSUE 15 PAGE 1931 CATEGORY 2 RPT#: NASA TM-81189 ADVANCED-TR-80-1-90 A-814-5 80/04/00 34 PAGES UNCLASSIFIED DOCUMENT

UTLT: Comparison of calculated and measured model rotor loading and wake geometry

AUTH: A/JOHNSON, W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Research and Technology Labs., Moffett Field, Calif.

MAJS: /HELICOPTER WAKES/ ROYAL WINGS/ ROTOR AERODYNAMICS
MINS: / BLADE TIPS/ FLOW DISTRIBUTION/ HELICOPTER PERFORMANCE/ VORTICES

ABA: Author

ABS: The calculated blade bound circulation and wake geometry are compared with measured results for a model helicopter rotor in hover and forward flight. Hover results are presented for rectangular tip and opposite tip airfoil blades. The correlation is quite good when the measured wake geometry characteristics are used in the analysis. Available prescribed wake geometry models are found to give fair predictions of the trailing, but they do not predict a reasonable prediction of the induced power. Forward flight results are presented for twisted and untwisted blades. Fair correlation between measurements and calculations is found for the bound circulation distribution on the advancing side. The tip vortex geometry in the vicinity of the advancing blade in forward flight was predicted well by the free wake calculation used, although the wake geometry did not have a significant influence on the calculated loading and performance for the cases considered.

BON1702347# ISSUE 12 PAGE 1515 CATEGORY 2 RPT#: NASA TM-47622 ADVANCED-TR-79-94 A-756C 80/03/00 131 PAGES UNCLASSIFIED DOCUMENT

UTLT: An experimental evaluation of a helicopter rotor section designed by numerical optimization

AUTH: A/HICKS, R. M.; B/MCCROSKEY, W. J.; PAA: B/Army Aviation Res. and Development Command, St. Louis, Mo.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJS: /COMPUTERIZED DESIGN/HELICOPTER DESIGN/ ROTOR WINGS
MINS: / AERODYNAMIC DRAG/ LIFT/ MACH NUMBER/ PITCHING

ABA: M.G.

ABS: The wind tunnel performance of a 10 percent thick helicopter rotor section design by numerical optimization is presented. The model was tested at Mach number from 0.2 to 0.84 with Reynolds number ranging from 1,900,000 at Mach 0.2 to 4,000,000 at Mach numbers above 0.5. The airfoil section exhibited maximum lift coefficients greater than 1.3 at Mach numbers less than 0.45 and a drag divergence Mach number of 0.82 for lift coefficients near 0. A moderate 'drag creep' is observed at low lift coefficients for Mach numbers greater than 0.6.

BON1702347# ISSUE 6 PAGE 703 CATEGORY 8 RPT#: NASA TP-1431 A-7777 80/01/00 63 PAGES UNCLASSIFIED DOCUMENT

UTLT: Effects of primary rotor parameters on flapping dynamics

AUTH: A/CHEN, R. I.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJS: /FLAPPING HINGES/HELICOPTER PERFORMANCE/ RIGID ROTORS/ ROYAL WINGS/ ROTOR AERODYNAMICS
MINS: / AERODYNAMIC STABILITY/ DYNAMIC RESPONSE/ EQUATIONS OF MOTION/ FLIGHT CHARACTERISTICS

ABA: U.M.S.

ABS: The effects of flapping dynamics of four main rotor design features that influence the agility, stability, and operational safety of helicopters are studied. The parameters include flapping hinge offset, flapping hinge restraint, pitch-flap coupling, and blade lock number. First, the flapping equations of motion are derived that explicitly contain the design parameters. The dynamic equations are then developed for the tip-path plane, and the influence of individual and combined variations in the design parameters determined. The steady state flapping response is examined with respect to control input and aircraft angular rate which leads to a feedforward control law for control decoupling through cross feed, and a feedback control law to decouple the steady state flapping response. The condition for achieving perfect decoupling of the flapping response due to aircraft pitch and roll rates without using feedback control is also found for the hover case. It is indicated that the frequency of the regressing flapping mode of the rotor system can become low enough to require consideration in the assessment of handling characteristics.
A comprehensive presentation is made of the engineering analysis methods used in the design, development, and evaluation of helicopters. After an introduction covering the fundamentals of helicopter rotors, configuration, and operation, the text delves into horizontal and vertical flight dynamics, including lift, drag, stability, and control. The text covers topics such as: (1) vertical flight, including momentum, blade element, and vortex theories; induced power, vertical drag, and ground effect; (2) forward flight, including general velocity and vortex theory for mode such phenomena as rotor flapping and its higher harmonics, tip loss and rotor control, compressibility, and pitch-flap coupling; (3) hover and forward flight performance assessments; (4) horizontal rotor design; (5) rotor wing aerodynamics; (6) rotor wing structural dynamics, including flutter, flap-lag dynamics, ground resonance, and vibration loads; (7) helicopter aeroelasticity; (8) stability and control (including secondary controls); (9) stall; and (10) noise.
A group of simulator experiments were conducted on the
Flights Simulator for Advanced Aircraft at Ames
Research Center to investigate the influence of
some static stability and stability/controllability
effects on the rolling quality of aircraft during
flight. The conditions included light turbulence
were examined. Two levels of static stability in each
rotational axis (pitch, roll, yaw) were examined for a
hingeless rotor configuration. The variations in pitch
and roll were: (1) stable and (2) neutral static stability.
In yaw there were two stable levels. Four
types of stability/control augmentation were also
examined for the lower level of static stability in
each axis. This latter investigation covered a three
combination of helicopter rotor types: hingeless, articulated, and
teetering. Four pilots performed a total of 105
evaluations of these parameters for a representative
VOR instrument approach task. Pilot rating results
indicate the acceptability of neutral static stability
genomically and laterally and the need for
pitch-roll attitude augmentation to achieve a
satisfactory system.

Navigation errors encountered during weather mapping
radar for helicopter IFR guidance to oil rigs
AUTH: A/PHILLIPS J. D.; B/BULL J. S.; C/HEGARTY D. M.;
D/DUCAN, D. C. PAA: D/NASA, Ames
Research Center, Moffet Field, CA
CORP: National Aeronautics and Space Administration. Ames
Research Center, Moffet Field, Calif.
In: American Helicopter Society. Annual Forum, 36th,
(A81-40136 10-01) Washington, DC, American Helicopter
MAJS: /FLIGHT TESTS/HELIICOPTER CONTROL/INSTRUMENT ERRORS
/INSTRUMENT FLIGHT RULES/INTEGRATION RADAR/GPS
NAVIGATION INSTRUMENTS/OIL EXPLORATION
MINS: /AIRCRAFT GUIDANCE/OFFSHORE ENERGY SOURCES/PILOT TRAINING/POSITION ERRORS/RADAR RANGE/RANGE ERRORS
ABA: (Author)

In 1978 a joint NASA-FAA helicopter flight test was
conducted to examine the use of weather-mapping radar
for IFR guidance during landing approaches to oil rig
helipads. The following navigation errors were
measured: total system error, range error, radar-bearing error, and flight technical error. Three
problem areas were identified: (1) Operational
problems leading to pilot blunders, (2) poor
navigation to the downwind final approach point, and
(3) pure homing on final approach. Analysis of these
problem areas suggested improvements in the radar
equipment, approach procedures, and pilot training,
and gives valuable insight into the development of future
navigation aids to serve the offshore oil industry.

Computerized three-dimensional aerodynamic design of a
lifting rotor blade
Research Center, Moffet Field, CA
CORP: National Aeronautics and Space Administration. Ames
Research Center, Moffet Field, Calif.
In: American Helicopter Society. Annual Forum, 36th,
(A81-40136 10-01) Washington, DC, American Helicopter
MAJS: /COMPUTERIZED DESIGN/HELICOPTER DESIGN/HEADING
ROTORS/RADAR AERODYNAMICS/ROTOR BLADES
TURBOMACHINERY
MINS: /AIRCRAFT DESIGN/HELICOPTER PERFORMANCE/LEADING
EDGES/PRESSURE DISTRIBUTION/SHAPE
ABA: (Author)

In a three-dimensional, inviscid, full-potential lifting
rotor code was used to demonstrate that pressure
distributions on both advancing and retreating blades
could be significantly improved by introducing local
airfoil sections. The perturbations were described by
simple geometric shape functions. To illustrate the
procedure, an example calculation was made at a
free-steam of 65 m/sec (115 knots) and an
advance ratio of 0.385. It was found that a minimum
of three shape functions was required to improve the
pressures without producing undesirable secondary
effects. In high-speed forward flight on a hypothetical
modern rotor blade initially having a NACA 4415
supercritical airfoil. Reductions in the shock
strength on the advancing blade could be achieved,
while simultaneously lessening leading-edge pressure
gradients on the retreating blade. The major blade
section modifications required were blunting of the
upper surface leading edge and some reshaping of the
blade's upper surface resulting in moderately thicker
airfoils.
flying qualities and the effects of control system augmentation for nap-of-the-earth (NOE) agility and instrument flying tasks were analyzed to assess handling-quality factors common to both tasks. Precise attitude control was determined to be a key requirement for successful accomplishment of both tasks. Factors that degraded attitude controllability were improper levels of control sensitivity and damping and rotor-system cross-coupling due to helicopter angular rate and collective pitch input. Application of rate-command, attitude-command, and control-input decoupling augmentation schemes enhanced attitude control and significantly improved handling qualities for both tasks. NOE agility and instrument flying handling-quality considerations, pilot rating philosophy, and supplemental flight evaluations are also discussed.
A new approach to active control of rotorcraft vibration


MAJS: /ACCELERATION PROTECTION/ AIRCRAFT CONTROL/ FEEDBACK CONTROL/ ROTORCRAFT AIRCRAFT/ STRUCTURAL VIBRATION/ VIBRATION DAMPING

MINS: / AIRCRAFT DESIGN/ DEGREES OF FREEDOM/ FLIGHT SIMULATION/ FUSELAGES/ PHASE SHIFT/ RESONANT FREQUENCIES/ STATE VECTORS

ABA: (Author)

ABS: A state-variable feedback approach is utilized for active control of rotorcraft vibration. Fuselage accelerations are passed through undamped second-order filters with resonant frequencies at N/rev. The resulting outputs contain predominantly the N/rev vibration components, phase shifted by 180 deg, and are used to drive the blade pitch to cancel this component of fuselage vibration. The linear-quadratic-gaussian (LQG) method is used to design a feedback control system utilizing these filtered accelerations. The design is based on a nine-degree-of-freedom linear model of the Rotor System Research Aircraft (RSRA) in hover and is evaluated on a nonlinear blade-element simulation of the RSRA for this flight condition. The system is shown to essentially eliminate vibrations at N/rev in all axes. The required blade pitch amplitude is within the capability of conventional actuators at the N/rev frequency.

BOA45556* ISSUE 19 PAGE 3454 CATEGORY 5 RPT#: AIAA 80-1778 80/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Multicyclic control for helicopters - Research in progress at Ames Research Center

AUTH: A/McCloud, J. L., III PAA: A/ (NASA, Ames Research Center, Moffett Field, Calif.)

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.


MAJS: /HELICOPTER CONTROL/ HELICOPTER TAIL ROTORS/ ROTARY WINGS/ STRUCTURAL VIBRATION

MINS: / DURING MISSION/ FEEDBACK CONTROL/ GUST ALLEVIATORS/ PITCHING MOMENTS/ STRUCTURAL STABILITY

ABA: (Author)

ABS: The term multicyclic control describes a blade pitch control technique used by helicopter designers to alleviate vibration in rotorcraft. Because rotor-induced vibrations are periodic, a multicyclic system, synchronized to the main rotor's azimuth
position, is suitable. Many types of rotors - ranging from the jet-flap and circulation-control rotors to the conventional full-blade feathering rotors - have utilized multicycle control. Multicycle control systems may be designed to reduce blade-bending stresses, to reduce rotor-induced vibration, and to improve rotor performance. Rotor types are reviewed, primarily to highlight their differences. The increased use of composites in blade construction is seen to indicate that vibration alleviation will be the prime focus of multicycle control. Adaptive feedback control systems, which also incorporate gust alleviation, are considered to be the ultimate application of multicycle control.

AUTH: A. McCloud, T. L. III
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

The promise of multicycle control - for helicopter vibration reduction

ABS: The rough ride a helicopter endures is known to be self-generated. This roughness results in fatiguing blade loads and vibration which can be eliminated or greatly reduced by multicycle control. Rotor performance may also be improved. Several types of rotors which have employed multicycle control are reviewed and compared. Their differences are highlighted and their potential advantages and disadvantages are discussed. The flow field these rotors must operate in is discussed, and it is shown that simultaneous elimination of vibration and oscillatory blade loads is not an inherent solution to the roughness problem. The use of rotor blades and energy absorbers is proposed. Input-output relations are considered and a gain control for ROMULAN, a multicycle controlling computer program, is introduced. Implications of the introduction of multicycle systems into helicopters are also discussed.
MATHMATICAL MODELS/ROTARY WINGS
MINS: AERODYNAMIC CONFIGURATIONS/ AERODYNAMIC LOADS/
AEROELASTICITY/ NONLINEAR EQUATIONS/ ROTOR
AERODYNAMICS
ABA: A.W.H.
ABS: The governing equations of motion of a helicopter
rotor coupled to a rigid body fuselage are derived. A
consistent formulation is used to derive nonlinear
periodic coefficient equations of motion which are
used to study coupled rotor/fuselage dynamics in
forward flight. Rotor/fuselage coupling is documented
and the importance of an ordering scheme in deriving
nonlinear equations of motion is reviewed. The nature
of the final equations and the use of multiblade
coordinates are discussed.

BON14107* ISSUE 5 PAGE 565 CATEGORY 5 RPT#: NASA-CASE-ARC-11106-1 US-PATENT-4,168,939
7/9/09/25 23 PAGES UNCLASSIFIED DOCUMENT
Filed 8 Sep. 1977 Supersedes N77-31130 (15 - 22, p 2853)
UUTL: Accoustically swept rotor --- helicopter noise
reduction FLSP: Patent
AUTH: JOHNSON, F. H.; B/BOXWELL, D. A.; C/VASUE, R.
PAT: C/inventors (to NASA)
CORP: National Aeronautics and Space Administration. Ames
MAJS: AEROCUSTICS/AERODYNAMIC NOISE/NOISE REDUCTION*
ROTARY WINGS/ROTOR AERODYNAMICS/ SWEET EFFECT
MINS: FAR FIELD/ FLOW DISTRIBUTION/ HELICOPTERS/
MATHMATICAL MODELS/PATENTS/ TAIL ROTORS
ABA: Official Gazette of the U.S. Patent and Trademark
Office
ABS: Impulsive noise reduction is provided in a rotor blade
by acoustically sweeping the chord line from root to
tip so that the acoustic radiation resulting from the
summation of potential singularities used to model the
flow about the blade tend to cancel for all times at
an observation point in the acoustic far field.

79N32205* ISSUE 23 PAGE 3043 CATEGORY 6 RPT#: NASA-IN-76811 A-3/2920 7/9/09/00 61 PAGES
UNCLASSIFIED DOCUMENT
UUTL:收 XV-15 flight test results compared with design goals
AUTH: WERMICO, H. G.; B/MAEGER, J. P. PAA: A/Bell
Helicopter Textron. Fort Worth. Tex. I: B/NASA. Ames
MAJS: F/LIGHT TESTS/HOVERING STABILITY/ROTOR AERODYNAMICS
/TILT ROTOR RESEARCH AIRCRAFT PROGRAM/ WIND TUNNEL
MINS: AEROELASTICITY/ GRAPHS (CHARTS)/ MECHANICAL DRIVES/
NASA PROGRAMS/ ROTARY WINGS/ TABLES (DATA)
ABA: (Author)
ABS: Aircraft No. 2 is presently in the midst of flight
envelope expansion. Noise and safety design goals have
been demonstrated; preliminary results indicate that performance and component life goals may also be met.
Hovering power indicates a standard hover ceiling of 7,000 feet. After 18.0 hours of flight, a true airspeed of 207 knots has been reached. The goal is a 303-knot cruise speed. So far, XV-15 flight tests indicate no reason why the tilt rotor concept should not fulfill its promise to provide a major step forward in air vehicle flexibility and in rotor wing performance.

79N31137# ISSUE 22 PAGE 2895 CATEGORY 1 RPT:
NASA-TM-78621 A-7955 79/08/00 36 PAGES
UNCLASSIFIED DOCUMENT

AUTH: J. L. III
SAP: HC A03/MF A01

MAJS: \/*BLADE TIPS*/FLIGHT CONTROL/**HELICOPTER CONTROL/*HELICOPTERS/*LIFTING ROTORS*/ROTOR AERODYNAMICS/*VIBRATION/*VIBRATION DAMPING

MINS: \/*BENDING MOMENTS*/FEEDBACK CONTROL*/FLIGHT CHARACTERISTICS**FLIGHT SAFETY*/FLOW DISTRIBUTION*/HELICOPTER PERFORMANCE*/INPUT/OUTPUT ROUTINES*/JET FLAPS

ABA: A.W.H.

ABS: Several types of rotors which employ multicyclic control are reviewed and compared. Their differences are highlighted and their potential advantages and disadvantages are discussed. The flow field these rotors must operate in is discussed, and it is shown that simultaneous elimination of vibration and oscillatory blade loads is not an inherent solution to the roughness problem. The use of rotor blades as energy absorbers is proposed. Input-output relations are considered and a gain control for ROMULAN, a multicyclic controlling computer program, is introduced. Implications of the introduction of multicyclic systems into helicopters are discussed.

79A47608# ISSUE 21 PAGE 3601 CATEGORY 5
79/06/00 8 PAGES UNCLASSIFIED DOCUMENT

AUTH: Recent V/S10L Aircraft Designs


Original Page is of Poor Quality
To ensure that the XV-15 tilt rotor research aircraft will meet the requirements of the program plan and the contract model specification and statement of work, one of the two aircraft will be tested in the Ames 40 x 80 feet wind tunnel to provide an initial assessment of the aerodynamic characteristics, structural loads, and rotor/pylon/wing dynamics in a simulated flight environment for correlation with calculated values. The tests will also serve to verify the functional instrumentation in a flight environment. The management structure, operational plan, support requirements and responsibilities, safety provisions and reporting requirements for conduct of the wind tunnel tests are defined and related to other phases of the program.

 configurations. The stability and control augmentation systems (SCAS) include simple control augmentation systems to decouple pitch and yaw responses due to collective input and to quicken the pitch and roll control responses; SCAS of rate-command type designed to optimize the sensitivity and damping and to decouple the pitch-roll due to aircraft angular rate; and attitude-command type SCAS. Pilot ratings and commentary are presented as well as performance data related to the task. SCAS control usages and their gain levels associated with specific rotor types are also discussed.

CONTROL DISPLAY REQUIREMENTS FOR HELICOPTERS CONTROLLING DECELERATING APPROACHES IN THE TERMINAL AREA UNDER INSTRUMENT METEOROLOGICAL CONDITIONS WERE SURVEYED. THE PROGRAMS WERE ORGANIZED ON THE BASIS OF THE CONTROL AUGMENTATION CONCEPTS THAT WERE CONSIDERED AND THE RESULTS ARE SUMMARIZED AND COMPARED. NINE CONTROL DISPLAY COMBINATIONS ARE HYPOTHESIZED AS POSSIBLE CANDIDATES FOR FUTURE GROUND AND IN-FLIGHT INVESTIGATION. SPECIFIC GUIDELINES FOR THE GUIDANCE RELATIONSHIP, CONTROL CHARACTERISTICS, AND DISPLAY PRESENTATION CONCEPTS ARE GIVEN.

79719122# ISSUE 12 PAGE 1222 CATEGORY 2 RPT#: NASA-TM-78557 A-7731 79/03/00 34 PAGES UNCLASSIFIED DOCUMENT

UTIL: Inertial dynamics of a general purpose rotor
AUTH: A/DUVAL, R. W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL: NTIS
SAP: HC A03/MF A01
MAJS: / EQUATIONS OF MOTION/ ROTARY WINGS/ ROTOR SYSTEMS RESEARCH AIRCRAFT
MINS: / DATA PROCESSING/ FLAPPING/ MATHEMATICAL MODELS/ ROTARY STABILITY
Airborne weather and mapping radar is a near-term, economical method of providing 'self-contained' navigation information for approaches to offshore oil rigs and its use has been rapidly expanding in recent years. A joint NASA/FAA flight test investigation of helicopter IFR approaches to offshore oil rigs in the Gulf of Mexico was initiated in June 1976 and conducted under contract to Air Logistics. Approximately 120 approaches were flown in a Bell 212 helicopter by 15 operational pilots during the months of August and September 1978. The purpose of the tests was to collect data to support development of advanced radar flight director concepts by NASA and to aid the establishment of Terminal Instrument Procedures (TERPS) criteria by the FAA. The flight test objectives were to develop airborne radar approach procedures, measure tracking errors, determine acceptable weather minimums, and determine pilot acceptability. Data obtained will contribute significantly to improved helicopter airborne radar approach capability and to the support of exploration, development, and utilization of the Nation's offshore oil supplies.

79A-49078# ISSUE 21 PAGE 3922 CATEGORY B RPT#: AHS 79-26 79/00/00 27 PAGES UNCLASSIFIED DOCUMENT

UTIL: Piloted simulator investigation of helicopter control systems effects on handling qualities during instrument flight

AUTH: A/PHATAK, A. V.; B/PEACO, L. L., JR.; C/DESS, R. A.; D;ROSS, V. L.; E/HALL, G. W.; F/GERDES, R. W. FAA


79A-49078# ISSUE 21 PAGE 3922 CATEGORY B RPT#: AHS 79-26 79/00/00 27 PAGES UNCLASSIFIED DOCUMENT

UTIL: Piloted simulator investigation of helicopter control systems effects on handling qualities during instrument flight

AUTH: A/PHATAK, A. V.; B/PEACO, L. L., JR.; C/DESS, R. A.; D;ROSS, V. L.; E/HALL, G. W.; F/GERDES, R. W. FAA


MINS: /FLIGHT CONDITIONS/ INSTRUMENT LANDING SYSTEMS/ LANDING AIDS/ METEOROLOGICAL RADAR/ PRODUCT DEVELOPMENT/ RADAR MAPS/ TABLES (DATA)

ABS: An exploratory piloted simulation was conducted to investigate the effects of the characteristics of helicopter flight control systems on instrument flight handling qualities. This joint FAA/NASA study was motivated by the need to improve instrument flight capability. A near-term objective is to assist in updating the airworthiness criteria for helicopter instrument flight. The experiment consisted of variations of single-rotor helicopter types and levels of stability and control augmentation systems (SCAS). These configurations were evaluated during an omni-range approach task under visual and instrument flight conditions. The levels of SCAS design included a simple rate damping system, collective decoupling, plus rate damping, and an attitude command system with collective decoupling. A limited evaluation of stick force versus airspeed stability was accomplished. Some problems were experienced with control system mechanism which had a detrimental effect on longitudinal stability. Pilot ratings, pilot commentary, and performance data related to the task are presented.

79A-45413# ISSUE 19 PAGE 3557 CATEGORY B RPT#: AHS 79-1686 79/00/00 15 PAGES UNCLASSIFIED DOCUMENT

UTIL: A piloted simulator investigation of helicopter precision instrument approaches to hover to determine single-pilot IFR/SPIFR/ requirements

AUTH: A/PHATAK, A. V.; B/PEACO, L. L., JR.; C/DESS, R. A.; D;ROSS, V. L.; E/HALL, G. W.; F/GERDES, R. W. FAA


MINS: /FLIGHT CONDITIONS/ INSTRUMENT LANDING SYSTEMS/ LANDING AIDS/ METEOROLOGICAL RADAR/ PRODUCT DEVELOPMENT/ RADAR MAPS/ TABLES (DATA)

ABS: An exploratory piloted simulation was conducted to investigate the effects of the characteristics of helicopter flight control systems on instrument flight handling qualities. This joint FAA/NASA study was motivated by the need to improve instrument flight capability. A near-term objective is to assist in updating the airworthiness criteria for helicopter instrument flight. The experiment consisted of variations of single-rotor helicopter types and levels of stability and control augmentation systems (SCAS). These configurations were evaluated during an omni-range approach task under visual and instrument flight conditions. The levels of SCAS design included a simple rate damping system, collective decoupling, plus rate damping, and an attitude command system with collective decoupling. A limited evaluation of stick force versus airspeed stability was accomplished. Some problems were experienced with control system mechanism which had a detrimental effect on longitudinal stability. Pilot ratings, pilot commentary, and performance data related to the task are presented.
Guidance law, (4) level of stability and command augmentation, (5) cockpit display sophistication, (6) accuracy of navigation aids, and (7) help aid lighting and visual aids. Particular emphasis is placed on the relative effects of deceleration profile, control augmentation, and flight director parameters on pilot performance, workload, and opinion rating. Problems associated with the development of a pilot acceptance analytical methodology are outlined.

79A45345*# ISSUE 19 PAGE 2555 CATEGORY B RPT#: AIAA 79-1683 79/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UUTL: A review of helicopter control-display requirements for accelerating instrument approach


CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.


MAUS: /AIRCRAFT STABILITY/APPRAACH CONTROL/*DISPLAY DEVICES/*FLIGHT CONDITIONS/*HELICOPTER PERFORMANCE/* INSTRUMENT APPROACH

MINS: / AIRCRAFT GUIDANCE/ DIRECTIONAL CONTROL/FLIGHT CONTROL/FLIGHT TESTS/GROUND BASED CONTROL/LATERAL CONTROL

ABA: (Author)

ABS: This paper reviews research and operational test programs that have dealt with control and display requirements for helicopters performing decelerating approaches in the terminal area under instrument flight conditions. A survey of literature concentrating on flight programs resulted in approximately 50 applicable references which were summarized and classified according to the type of stability/control augmentation that was emphasized. On this basis, display information requirements for each control system type were hypothesized consistent with documented results of these programs. Nine control-display combinations that appear to warrant further ground simulation and flight testing are defined and discussed.

79A29006*# ISSUE 11 PAGE 2046 CATEGORY 39 RPT#: AIAA 79-0732 CNT#: N50-3082 NGR-05-007-414 79/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UUTL: Formulation of the aerelastic stability and response problem of coupled rotor/support systems


CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.: California Univ. Los Angeles.


MAUS: /AEROELASTICITY/DYNAMIC STABILITY/*ROUTERS/* STRUCTURAL STABILITY/*SYSTEMS STABILITY

MINS: / EQUATIONS OF MOTION/ NONLINEAR EQUATIONS/ PYLONS/ ROTARY WINGS/ SUPPORTS/ WINDMILLS/ WINDPOWERED MACHINES

ABA: (Author)

ABS: The consistent formulation of the governing nonlinear equations of motion for a coupled rotor/support system is discussed. Rotor/support coupling is clearly documented by enforcing dynamic equilibrium between the rotor and the moving flexible support. The nonlinear periodic coefficient equations of motion are applicable to both coupled rotor/aileron aerelastic problems of helicopters in hover or forward flight and coupled rotor/tower dynamics of a large horizontal axis wind turbine (HAWT). Finally, the equations of motion are used to study the influence of flexible support and nonlinear terms on rotor aerelastic stability and response of a large two-bladed HAWT.
access service. The access systems offer a viable alternative for air passengers placing a high value on their time, and provides the opportunity for better integrating the air transportation service of multiple airports in a given urban region.

7912019# ISSUE 3 PAGE 274 CATEGORY 2 APT# NASA-TM-85939avorscom-TR-76-56(A) A-7661 78/11/00 18 PAGES UNCLASSIFIED DOCUMENT

UTIL: Comprehensive helicopter analysis: A state of the art review
AUT: A./JOHNSON, W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif., Army Aviation Research and Development Command, Moffett Field, Calif.
AVAIL NTIS: SAP: HC 102/DF-401
Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif.

7912019# ISSUE 7 PAGE 921 CATEGORY 9 78/10/00 17 PAGES UNCLASSIFIED DOCUMENT

UTIL: Mission environment simulation for Army rotorcraft development: Requirements and capabilities
AUT: A./KEY, D. L.; B./GIDEL, B. L. (C)/SICARTI, J. B.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif., Army Aviation Research and Development Command, Moffett Field, Calif.
AVAIL NTIS: SAP: HC 114/DF-31
Prepared in cooperation with Army Aviation Res. and Develop. Command, Moffett Field, Calif.

MAJS: /*AERODYNAMIC CHARACTERISTICS/* COMPUTERIZED DESIGN/* HELICOPTERS/* TECHNOLOGY ASSESSMENT
MINS: /* AERODYNAMIC LOADS/ AEROGASITICITY/ CONTROLLABILITY/ DYNAMIC STRUCTURAL ANALYSIS/ STRUCTURAL VIBRATION
ABA: Author

7911597# ISSUE 7 PAGE 274 OF 170

ORIGINAL PAGE 15

OF POOR QUALITY

TERMINAL 20 PAGE 33 (ITEMS 97 - 99 OF 170)
DEVICES/ VISIBILITY

ABA: G.Y.

ABS: The rich and varied detail visible in terrain flight must be presented by a wide field-of-view system with much detail and high resolution. The rotary-wing R&D simulator must have great versatility for easy change of cab configurations and the capability to accommodate a two or three man crew. Basic specifications for an adequate visual display were developed and compared with current and forecasted techniques for image generation and presentation. Results of a study performed to determine the feasibility of meeting these requirements using the current technology of TV camera-model image generation and projected display are discussed and an assessment of the possibility that computer generated imagery can achieve the desired level of detail is presented.

79110046** ISSUE 1 PAGE 7 CATEGORY 5 RPT#: NASA-TM-78522 A-7602 78/09/00 30 PAGES UNCLASSIFIED DOCUMENT

UTIL: Flight research capabilities of the NASA/Army rotor systems research aircraft

AUTH: A/WHTICE, S., JR.; B/CONDON, G. W.


MAJS: */ROTOR SYSTEMS RESEARCH AIRCRAFT

MINS: */EFFICIENCY/ EVALUATION/ RESEARCH

ABA: L.S.

ABS: A description is given of the capabilities and limitations of the Rotor Systems Research Aircraft (RSRA) that was demonstrated during the development contract, and assesses the expected research capabilities of the RSRA on delivery to the government.

78A09990** ISSUE 22 PAGE 3969 CATEGORY 9 RPT#: AIAA PAPER 78-1515 78/08/00 12 PAGES UNCLASSIFIED DOCUMENT

UTIL: V/STOL aircraft simulation - Requirements and capabilities at Ames Research Center


MAJS: */COMPUTERIZED SIMULATION*/FLIGHT CONTROL*/FLIGHT SIMULATION*/FLIGHT SIMULATORS*/V/STOL AIRCRAFT

MINS: */AIRCRAFT DESIGN/ AIRCRAFT PERFORMANCE/ DIAGRAMS/

EQUATIONS OF MOTION/ GROUND TESTS/ SYSTEMS ANALYSIS/ TECHNOLOGY ASSESSMENT/ TERRAIN ANALYSIS

ABA: (Author)

ABS: Ground-based flight simulation contributes greatly to the development of new aircraft and flight management systems and will be especially important in improving the performance, safety, and environmental characteristics of future civil and military V/STOL aircraft. This paper describes existing simulation facilities at Ames Research Center and discusses their capabilities and limitations for V/STOL aircraft investigations. Simulation requirements for NASA research and support of DOD programs are also discussed, including technology development for advanced rotorcraft and civil and military V/STOL aircraft. Current efforts and future plans are described for the upgrading of Ames simulation facilities to meet those requirements. Recent advances in equipment technology and operational methodology are shown to provide significantly improved simulation fidelity through better motion and visual cues and faster system response to pilot inputs.

79110864** ISSUE 1 PAGE 114 CATEGORY 71 78/08/00 21 PAGES UNCLASSIFIED DOCUMENT

UTIL: Aeroacoustic research: An Army perspective

AUTH: A/MORSE. H. A.; B/SCMITZ. F. H.


MAJS: */AEROACoustics*/AIRCRAFT NOISE*/HELICOPTERS*/RESEARCH MANAGEMENT

MINS: */AERODYNAMIC NOISE*/HELICOPTER PERFORMANCE/ MILITARY TECHNOLOGY/ NASA PROGRAMS*/NOISE REDUCTION/ ROTARY WINGS

ABA: J.M.S.

ABS: A short perspective of the Army aeroacoustic research program is presented that emphasizes the performance of aerodynamically generated noise. Exciting breakthroughs in experimental techniques and facilities are reviewed which are helping build a detailed understanding of helicopter noise. Army and joint Army/NASA supported research programs in acoustics which promise to reduce the noise of future helicopters without severe performance penalties are included.

TERMINAL 20 PAGE 34 (ITEMS 100-102 OF 170)
78N32835# ISSUE 23 PAGE 3139 CATEGORY 71
78/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UTTIL: A study of the noise radiation from four helicopter rotor blades -- tests in Ames 40 by 20 foot wind tunnel

AUTH: A. LEE, A.; B/MOSHER, M. PAA: A/Beam Eng., Inc.)
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL.NTIS
SAP: HC A17/MF A01
In NASA Langley Res. Center Helicopter Acoustics p 387-402 (SEE N78-32816 23-71)

MAJS: /*AIRCRAFT NOISE/*HELICOPTERS/*NOISE PROPAGATION/*ROTARY WINGS/*WIND TUNNEL TESTS
MINS: /*AERACOUSTICS/*BLADE TIPS/*NOISE POLLUTION/*NOISE REDUCTION/* POLLUTION CONTROL/* ROTOR AERODYNAMICS/*THICKNESS RATIO

ABA: J.M.S.

ABS: Accoustic measurements were taken of a modern helicopter rotor with four blade tip shapes in the NASA Ames 40-by-80-Foot Wind Tunnel. The four tip shapes are: rectangular, swept, trapezoidal, and swept tapered in platform. Acoustic effects due to tip shape changes were studied based on the OBA level, peak noise pressure, and subjective rating. The swept tapered blade was found to be the quietest above an advancing tip Mach number of about 0.9, and the swept blade was the quietest at low speed. The measured high frequency impulsive noise was compared with theoretical predictions based on thickness effects; good agreement was found.

78N32831# ISSUE 23 PAGE 3138 CATEGORY 71
78/08/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Hovering impulsive noise: Some measured and calculated results

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL.NTIS
SAP: HC A17/MF A01

MAJS: /*AIRCRAFT NOISE/*HELICOPTERS/*HOVERING/*ROTARY WINGS
MINS: /*AERACOUSTICS/*BLADE TIPS/*NOISE POLLUTION/*POLLUTION CONTROL/*PREDICTION ANALYSIS TECHNIQUES

ABA: J.M.S.

ABS: In-plane impulsive noise radiating from a hovering model rotor was measured in an anechoic environment. The hover acoustic signature was compared with existing theoretical prediction models with previous forward flight experiments using the same model rotor.

These hover tests showed good experimental consistency with forward flight measurements, both in pressure level, and waveform character. over the range of Mach numbers tested (0.8 to 1.0). Generally poor correlation, however, was confirmed with current linear theory prediction efforts. Failure to predict both the peak pressure levels and the shape was reported, especially with increasing tip Mach number.
MINS: DAMPING TESTS/ DYNAMIC RESPONSE/ ROTOR SPEED/ SCALE MODELS/ VACUUM TESTS
ABA: Author
ABS: Model tests of a 1.82 m diameter rotor were performed to investigate the aeromechanical stability of coupled rotor-body systems in hover. Experimental measurements were made of modal frequencies and damping over a wide range of rotor speeds. Good data were obtained for the frequencies of the rotor lead-lag regressing mode. The quality of the damping measurements of the body modes was poor due to nonlinear damping in the gimbal ball bearings. Simulated vacuum testing was performed using substitute blades of tantalum that reduced the effective lock number to 0.2% of the model scale value while keeping the blade inertial constant. The experimental data were compared with theoretical predictions, and the correlation was in general very good.

78N27043# ISSUE 17 PAGE 2341 CATEGORY 99
RPT #: NASA-TM-78498 A-74B 78/06/00 24 PAGES
UNCLASSIFIED DOCUMENT

UTIL: Application of a cost/performance measurement system on a research aircraft project
AUTH: D/Diehl, J. D.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVAIL.NTIS
SAP: HC 056/MF A01

MAJS: AIRCRAFT PERFORMANCE/ AIRPLANE PRODUCTION COSTS/ PROCUREMENT MANAGEMENT/ PROJECT MANAGEMENT/ RESEARCH AIRCRAFT/ Tilt ROTOR RESEARCH AIRCRAFT PROGRAM
MINS: CONTRACT NEGOTIATION/ COST ANALYSIS/ GOVERNMENT/INDUSTRY RELATIONS/ PROCUREMENT POLICY
ABA: Author
ABS: The fundamentals of the cost/performance management system used in the procurement of two tilt rotor aircraft for a joint NASA/Army research project are discussed. The contractor's reporting system and the GPO's analyses are examined. The use of this type of reporting system is discussed. Recommendations concerning the use of like systems on future projects are included.

79N10947# ISSUE 1 PAGE 126 CATEGORY B5
78/05/00 35 PAGES UNCLASSIFIED DOCUMENT

UTIL: Planning for airport access: An analysis of the San Francisco Bay area. Technological options
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVAIL.NTIS
SAP: HC A13/MF A01

In its planning for airport access p 115-118 (SEE N79-10942 01-85)

MAJS: AIRPORT PLANNING/ SAN FRANCISCO BAY (CA)/ TECHNOLOGY ASSESSMENT/ URBAN TRANSPORTATION
MINS: AUTOMATIC CONTROL/ AUTOMOBILES/ COSTS/ HELICOPTERS/ HIGHWAYS/ HULLS (STRUCTURES)/ PASSENGER TRANSIT SYSTEMS/ VERTICAL TAKEOFF AIRCRAFT/ WATER VEHICLES
ABA: S.E.S.
ABS: Current transportation technology and expected technological trends are reviewed. These technologies are assessed within the framework of the airport access system in the San Francisco Bay area. Four types of technological options are considered: (1) automotive systems, (2) commuter air, (3) automated guideways, and (4) water systems.

79N21159# ISSUE 12 PAGE 1537 CATEGORY B RPT #: NASA-TM-79475 A-2367 78/04/00 11 PAGES
UNCLASSIFIED DOCUMENT

UTIL: A note on multicyclidal control by swashplate oscillation
AUTH: A/BIGGERS, J. C.; B/MCCLOUD, J. L.; III
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVAIL.NTIS
SAP: HC A02/MF A01

MAJS: AIRCRAFT PERFORMANCE/ AIRPLANE PRODUCTION COSTS/ PROCUREMENT MANAGEMENT/ PROJECT MANAGEMENT/ RESEARCH AIRCRAFT/ Tilt ROTOR RESEARCH AIRCRAFT PROGRAM
MINS: CONTRACT NEGOTIATION/ COST ANALYSIS/ GOVERNMENT/INDUSTRY RELATIONS/ PROCUREMENT POLICY
ABA: Author
ABS: It was shown that for two, three, or four bladed rotors, simple oscillation of the nonrotating swashplate controls can produce desired blade pitch schedules of the sort which were suggested for vibration alleviation. Equations were given which relate the swashplate motions to the resulting blade pitch schedules.

79N20917# ISSUE 11 PAGE 1501 CATEGORY 71
78/03/00 29 PAGES UNCLASSIFIED DOCUMENT

UTIL: Comparison of measured and calculated helicopter rotor impulsive noise w/ wind tunnel test data and prediction analysis techniques
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AVAIL.NTIS
SAP: HC A03/MF A01

MAJS: AIRCRAFT NOISE/ IMPULSE GENERATORS/ NOISE MEASUREMENT/ PREDICTION ANALYSIS TECHNIQUES/ ROTARY WINGS/ WIND TUNNEL TESTS
MINS: BLADE N1S/ HELICOPTER PERFORMANCE/ NOISE REDUCTION/ SOUND PRESSURE
ABA: Author
ABS: The thickness noise theory is discussed. Two full-scale rotors were tested in a wind tunnel with several tips involving changes in chord, thickness, and sweep. Impulsive noise data reduction procedures used are described. The calculated and measured impulsive noise peak pressures as a function of advancing tip Mach number are compared, showing good correlation for all rotors considered.

78N20113# ISSUE 11 PAGE 1394 CATEGORY 5 RPT#: NASA-TM-78452 A-7134 78/03/00 17 PAGES UNCLASSIFIED DOCUMENT

UTL: A simple method for estimating minimum autorotative descent rate of single rotor helicopters
AUTH: A. Talbot, P. O. ; B. Schröers, L. G. ; PAA: B/Army R & T Labs., Moffett Field, Calif.)
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL NTIS SAP: HC A02/AF A01
MAJS: / Autorotation/*Descent Trajectories/*Helicopter Performance/*Rotary Wings
MINS: / Energy Consumption/ Estimates/ Flight Tests/ Free Flight/ Performance Prediction/ Prediction Analysis Techniques
ABA: Author

ABS: Flight test results of minimum autorotative descent rate are compared with calculations based on the minimum power required for steady level flight. Empirical correction factors are derived that account for differences in energy dissipation between these two flight conditions. A method is also presented for estimating the minimum power coefficient for level flight for any helicopter for use in the empirical estimation procedure of autorotative descent rate.

78N202055# ISSUE 13 PAGE 1658 CATEGORY 2 CNT#: NASA-TR-745-602 HSG-2253 78/02/00 32 PAGES UNCLASSIFIED DOCUMENT

UTL: Dynamic stall of an oscillating airfoil
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL NTIS SAP: HC A09/MF A01
In AGARD Unsteady Aerodyn. 32 p (SEE N78-22033 13-02) Sponsored in part by AREDL
MAJS: / Aerodynamic Stalling/*Airfoils/*Boundary Layer Separation/*Oscillations/*Unsteady Flow
MINS: / Helicopters/ Laminar Flow/ Navier-Stokes Equation/ Scale Models/ Vorticity/ Waves
ABA: Author

ABS: Unsteady separated boundary layers and wakes were studied by investigating flow past an oscillating airfoil which in part models the retreating blade stall on the helicopters. The Navier-Stokes equations in terms of the vorticity and stream function for laminar flow were solved to determine the flow field around a modified NACA 0012 airfoil. After a fully developed flow was determined at zero incidence, the airfoil was oscillated in pitch through an angle of attack range from 0 deg to 20 deg. The computed streamlines during this pitch motion are in qualitative agreement with the trajectories of air bubbles observed in water tunnel experiments conducted with a NACA 0012 airfoil under the same conditions. During the pitch-down motion of the airfoil, the computed flow patterns cannot be compared with the experiments because the trajectories of air bubbles intersect.

78N1B0043# ISSUE 9 PAGE 1110 CATEGORY 5 RPT#: NASA-TR-71459 A-7301-PT-1 78/02/00 102 PAGES UNCLASSIFIED DOCUMENT

UTL: Aeromechanical stability of helicopters with a bearingless main rotor. Part II: Equations of motion
AUTH: A. Hodges, D. H.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. Army Aviation Research and Development Command, Moffett Field, Calif. AVAIL NTIS SAP: HC A06/MF A01 Prepared in cooperation with Army Aviation Res. and Develop. Command, Moffett Field, Calif.
MAJS: / Aerodynamic Stability/Aeroelasticity/*Equations of Motion/*Helicopter Performance/*Rigid Rotor/*Rotary Wings
MINS: / Differential Equations/ Dynamic Structural Analysis/ Flexibility
ABA: Author

ABS: Equations of motion for a coupled rotor-body system were derived for the purpose of studying air and ground resonance characteristics of helicopters that have bearingless main rotors. For the fuselage, only four rigid body degrees of freedom are considered: longitudinal and lateral translations, pitch, and roll. The rotor is assumed to consist of three or more rigid blades. Each blade is joined to the hub by means of a flexible beam segment (flexbeam or strap). Pitch change is accomplished by twisting the flexbeam with the pitch-control system. The characteristics of which are variable. Thus, the analysis is capable of explicitly treating aerelastic couplings generated by the flexbeam elastic deflections, the pitch-control system, and the angular offsets of the blade and flexbeam. The linearized equations are written in the nonrotating system retaining only the cyclic rotor modes; thus, they comprise a system of homogeneous
ordinary differential equations with constant coefficients. All contributions to the linearized perturbation equations from inertia, gravity, quasi-steady aerodynamics, and the flexbeam equilibrium deflections are retained exactly.

79A18703* ISSUE 6 PAGE 49 CATEGORY B 78/00/00 28 PAGES UNCLASSIFIED DOCUMENT

UPTL: Flight research capabilities of the NASA/Army rotor systems research aircraft


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.: Army Research and Technology Laboratories, Fort Eustis, Va.


MAJ5: /HELI-COPIER DESIGN/MILITARY AIRCRAFT/NASA PROGRAMS

MINS: /AIRCRAFT CONFIGURATIONS/ CONTROLLABILITY/ CRITICAL LOADING/ HOVERING/ STRUCTURAL VIBRATION

ABA: B.J.

ABS: The paper reviews some of the recent technological developments in the United States in the field of rotorcraft and powered-lift research, with primary emphasis on the compound helicopter and the augmenter thrust approaches to vertical flight. The last several years have also seen significant developments in the State of the art through the combined use of wind tunnels, simulators, and research aircraft. The results of these developments are discussed to demonstrate the improvements that have been made in several of the important vehicle-related parameters. The prospect for further advances is also discussed.

79A19105 ISSUE 5 PAGE 754 CATEGORY 5 RPT#: AHS 78-64 78/00/00. 15 PAGES UNCLASSIFIED DOCUMENT

UPTL: Flap-lag-torsion aerelasticity of circulation-controlled rotors in hover


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.: Army Aviation Research and Development Command, Moffett Field, Calif.


MAJ5: /AIRCRAFT STABILITY/ATMOSPHERIC CIRCULATION/FLAPS (CONTROL SURFACES)/HELI-COPIER CONTROL/HOVERING/ Rotorcraft aircraft

MINS: /AEROELASTICITY/ HELICOPTER DESIGN/ ROTOR BLADES/ TORSIONAL STRESS/ TRAILING EDGES/ VIBRATION DAMPING

ABA: (Author)

ABS: The results of a theoretical investigation of the flap-lag-torsion stability of circulation controlled rotors in hover are presented. Stability boundaries are presented as a function of thrust and lag frequencies, at several levels of damping coefficient, for flap frequencies of 1.1/rev and 1.8/rev. The effects of several parameters on the blade flap-lag stability are examined, including structural damping.

TERMINAL 20 PAGE 38 (ITEMS 114-116 OF 70)
structural coupling, pitch-lag and pitch-flap coupling, and the blade feathering motion. The trailing edge blowing can have a major impact on the blade aeroelastic stability, which should be considered in the rotor design. The implications of these results for the current CCR and X-Wing rotocraft designs are considered.

79A18181* ISSUE 5 PAGE 754 CATEGORY 5 RPT#: AHS 78-60 78/00/00 20 PAGES UNCLASSIFIED DOCUMENT

UTL#: Wind-tunnel test results of a full-scale multicylic controllable twist rotor


CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Kaman Aerospace Corp., Bloomfield, Conn.


MAJS: /BEARING MOMENTS/HELICOPTER CONTROL/HELICOPTER DESIGN/ROTARY WINGS/TWISTED WINGS/WIND TUNNEL TESTS

MINS: /AERODYNAMIC DRAG/AERODYNAMIC LOADS/FLIGHT CONDITIONS/ROTOR BLADES

ABA: P.T.H.

ABS: Results of wind tunnel testing of a multicylic controllable twist rotor at several flight conditions and advance ratios of 0.22 and 0.33 are evaluated. It is found that blade flatwise bending moments and root control actuator loads (fixed system) can be reduced with multicylic control. Flatwise bending moment reductions of 20-30% with concurrent 83% reductions in control loads were predicted. Analysis of profile power coefficients indicates a decrease in profile power coefficient of 0.00016, corresponding to a loss of 0.12 sq. m of equivalent drag area.

79A18055* ISSUE 5 PAGE 757 CATEGORY 8 RPT#: AHS 78-27 78/00/00 22 PAGES UNCLASSIFIED DOCUMENT

UTL#: A piloted simulator investigation of augmentation systems to improve helicopter nap-of-the-earth handling qualities


CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.


MAJS: /AIRCRAFT STABILITY/HELICOPTER CONTROL/HELICOPTER DESIGN/RIGID ROTORS/STABILITY AUGMENTATION

MINS: /CONTROLLABILITY/EIGENVALUES/EQUATIONS OF MOTION/FEEDBACK CONTROL/LEAST SQUARES METHOD/LINEAR SYSTEMS/OPTIMAL CONTROL

ABA: (Author)

ABS: A stability and control augmentation system (SCAS) was designed based on a set of comprehensive performance criteria. Linear optimal control theory was applied to determine appropriate feedback gains for the stability augmentation system (SAS). The helicopter was...
represented by six-degree-of-freedom rigid body equations of motion and constant factors were used as weights for state and control variables. The ratio of these factors flowed as a parameter for SAS analysis and values of the feedback gains were selected on this basis to satisfy three of the performance criteria for full and partial state feedback systems. A least squares design method was then applied to determine control augmentation system (CAS) cross feed gains to satisfy the remaining seven performance criteria. The SCAS gains were then evaluated by nine degree-of-freedom equations which include flapping motion and conclusions drawn concerning the necessity of including the pitch/regressing and roll/regressing modes in SCAS analyses.

The general tilt-propeller concept is discussed, and a more detailed look at the XV-15 aircraft is taken. The special features of the two-engine system, engine control system, and flight control system are mentioned. The main objectives of the XV-15 program are to (1) verify rotor/pylon/aerodynamic efficiency and aircraft performance over a representative operational envelope (2) assess the handling qualities and establish a safe operating envelope, and (3) investigate gust sensitivity, effects of downwash and hover operation. With regard to rotor/pylon stability, one challenge is to be able to predict a parameter's value and then build hardware to match. The analytical program has gained some respect through aerelastic and full-scale XV-15 demonstrations. Special concern centers around the thrust and power management system when flying at high speed when very small changes in rotor collective pitch represent large changes in thrust and power. Demonstration of the system awaits wind-tunnel and flight testing.
ABS: The design of future V/STOL aircraft is seen to revolve around tradeoffs of V/STOL capability with classical figures of merit. The Navy may soon drive V/STOL technology to the threshold of a major advancement. It has decided to proceed with a significant V/STOL effort and, based on results, decide whether or not to procure significant numbers and types of V/STOL aircraft. The author envisages a line of development beginning with Navy Type A multipurpose subsonic V/STOL aircraft, followed by derivatives for civil utility applications, followed ultimately by V/STOL commercial transports.

78A23B04* ISSUE 8 PAGE 1319 CATEGORY 5 RPT#: SAE PAPER 770953 77/11/10 10 PAGES UNCLASSIFIED DOCUMENT

UTIL: XV-15 tilt rotor test - Progress report


MAJS: /AIRCRAFT PERFORMANCE/FLIGHT TESTS/VTOL ROTOR AIRCRAFT/VERTICAL TAKEOFF AIRCRAFT/XV-15 AIRCRAFT

MINS: / AIRCRAFT DESIGN/ HELICOPTER PERFORMANCE/ TURBOPROP ENGINES

ABA: (Author)

ABS: In a continuing effort to expand the versatility of these aircraft, VTOL designers have for many years tried to combine the desirable features of various concepts into a single aircraft. This is a formidable task and most efforts have met with limited success. This paper examines the need for an aircraft combining the efficient high speed characteristics of a fixed wing turboprop. The ability of the tilt rotor concept to fill this requirement and its potential usefulness in both military and civil missions is discussed. The history of the concept and the status of the current Army/NASA/Bell XV-15 program and its role in proving the viability of the concept are reviewed.

78N10002+ ISSUE 1 PAGE 1 CATEGORY 1 RPT#: NASA- TM-78443 A-7227 77/09/00 40 PAGES UNCLASSIFIED DOCUMENT

UTIL: Calculated hovering helicopter flight dynamics with a circulation controlled rotor

AUTH: A/JOHNSON, W. W.; B/CHOPRA, K.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; V/STOL Aircraft Technology Div., Moffett Field, Calif.; AVALNTIS SAP: HC AO3/A01


MAJS: /AERODYNAMICS/FLIGHT CHARACTERISTICS/HELICOPTER CONTROL/ROTARY WINGS

MINS: / CIRCULATION/ HELICOPTER PERFORMANCE/ HOVERING STABILITY/ ROTOR LIFT/ ROTOR SPEED

ABA: Author

ABS: The influence of the rotor blowing coefficient on the calculated roots of the longitudinal and lateral motion was examined for a range of values of the rotor lift and the blade flap frequency. The control characteristics of a helicopter with a circulation controlled rotor are discussed. The principal effect of the blowing is a reduction in the rotor speed stability derivative. Above a critical level of blowing coefficient, which depends on the flap frequency and rotor lift, negative speed stability is produced and the dynamic characteristics of the helicopter are radically altered.

77N32076# ISSUE 23 PAGE 3024 CATEGORY 2 RPT#: NASA- TM-78434 77/09/00 30 PAGES UNCLASSIFIED DOCUMENT

UTIL: Effects of unsteady aerodynamics on rotor aerelastic stability

AUTH: A/KUNZ, D. I.

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Air Mobility Research and Development Lab., Moffett Field, Calif.; AVALNTIS SAP: HC AO2/A01

Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.

MAJS: /AERODYNAMIC STABILITY/AEROELASTICITY/ROTOR BLADES /WING OSCILLATIONS

MINS: / AERODYNAMIC FORCES/ EQUATIONS OF MOTION/ HELICOPTERS / VIBRATION DAMPING

ABA: Author

ABS: The effects of unsteady aerodynamics on the stability characteristics of helicopter rotor blades were studied. A simple physical model of each blade was used together with Theodorsen, Lowe's, and quasi-steady aerodynamics to derive the equations of motion. The stability analysis comparing the effects of using each
of the three theories revealed some significant differences between the Loewy and Theodorsen results. These included increased and decreases in lag damping, localized around integer lag frequencies. It was also shown that the standard method of multi-blade coordinates must be modified for use in conjunction with Loewy aerodynamics.

77N3174-# ISSUE 22 PAGE 2900 CATEGORY B RPT#: NASA-TM-73230 A-7017 77/08/00 46 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CORLISS, L. D.; B/TALBOT, P. D.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Air Mobility Research and Development Lab., Moffett Field, Calif.
MAJS: FLIGHT CONTROL/HELCHELTER CONTROL/MALFUNCTIONS/ SYSTEM FAILURES/UH-1 HELICOPTER
MINS: AUGMENTATION/AUTOMATIC CONTROL/FLIGHT SAFETY/MATHEMATICAL MODELS/SIMULATORS
ABA: Author

A two-plot moving base simulator experiment was conducted to measure the effects of servos failures of a flight control system on the transient dynamics of a Bell UH-1H helicopter. The flight control hardware considered was part of the V/SOLAM system built with control authorities of from 20-40'. Servo hardover and oscillatory failures were simulated in each control axis. Measurements were made to determine the adequacy of the failure monitoring system time delay and the servo center and lock time constant. The pilot reaction time, and the attitude and altitude excursions of the helicopter at hover and 60 knots. Safe recoveries were made from all failures under VFR conditions. Pilot reaction times were from 0.5 to 0.7 sec. Reduction of monitor delay times below these values resulted in significantly increased excursions envelopes. A subsequent flight test was conducted on a UH-1H helicopter with the V/SOLAM system installed. Series servo hardovers were introduced in hover and at 60 knots straight and level. Data from these tests are included for comparison.

77N28525-# ISSUE 19 PAGE 2543 CATEGORY 39 RPT#: NASA-TN-D-8515 A-6740 77/07/00 253 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aerodynamic analysis for rotorcraft in flight or in a wind tunnel
AUTH: A/HJOSCHEN, W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Air Mobility Research and Development Lab., Moffett Field, Calif.
MAJS: AERODYNAMIC/ROTORCRAFT AIRCRAFT/WIND TUNNEL TESTS
MINS: AERODYNAMIC DRAG/DESIGN ANALYSIS/EQUATIONS OF MOTION
ABA: Author

An analytical model is developed for the aerodynamic behavior of a rotorcraft in flight or in a wind tunnel. A unified development is presented for a wide class of rotors, helicopters, and operating conditions. The equations of motion for the rotor are derived using an integral Newtonian method, which gives considerable physical insight into the blade inertial and aerodynamic forces. The rotor model includes coupled flap-lag bending and blade torsion degrees of freedom, and is applicable to articulated, hingeless, gimbaled, and teetering rotors with an arbitrary number of blades. The aerodynamic model is valid for both high and low inflow, and for axial and nonaxial flight. The rotor rotational speed dynamics, including engine inertia and damping, and the perturbation inflow dynamics are included for a rotor on a wind-tunnel support, a normal mode representation of the test module, strut, and balance system is used. The aerodynamic analysis for the rotorcraft in flight is applicable to a total rotor aircraft, including single main-rotor and tandem helicopter configurations, and side-by-side or tilt-rotor aircraft configurations.

77N27105-# ISSUE 18 PAGE 2349 CATEGORY 5 RPT#: NASA-TM-73262 A-7115 77/06/00 29 PAGES UNCLASSIFIED DOCUMENT

UTTL: Calculated Dynamic characteristics of a soft-inplane hingeless rotor helicopter
AUTH: A/HJOSCHEN, W.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.; Army Air Mobility Research and Development Lab., Moffett Field, Calif.
MAJS: AERODYNAMIC/ROTORCRAFT AIRCRAFT/WIND TUNNEL TESTS
MINS: AERODYNAMIC DRAG/DESIGN ANALYSIS/EQUATIONS OF MOTION
ABA: Author

The dynamic behavior of a flexible hingeless rotor helicopter is calculated and compared with experimental data. The model includes the effects of blade flexibility, rotor dynamics, and aerodynamics. The results are presented for various inflow conditions and rotor speeds. The analytical predictions are found to be in good agreement with experimental data.
MAJS: /DYNAMIC CHARACTERISTICS/HELIQUETER DESIGN/RIGID RATORS MINS: / AERODYNAMIC STABILITY/ AEREOELASTICITY/ FLIGHT CHARACTERISTICS

ABA: Author

ABS: Calculated dynamic characteristics of a representative soft-inplane hingeless rotor helicopter are presented. The flight dynamics as a function of speed and gross weight are given. The requirements for accurate analytical modeling of this helicopter are established. The influence of the horizontal tail size, the rotor precone, the blade sweep, and the blade center of gravity/aerodynamic center offset on the calculated flight dynamics and aeroelastic stability are examined. The calculations show no evidence of an air resonance stability problem with this aircraft.

77W25605# ISSUE 17 PAGE 209 CATEGORY 1 RPT#: NASA-1M-x-73244 A-7047 77/05/00 33 PAGES UNCLASSIFIED DOCUMENT

UTTL: Helicopter optimal descent and landing after power loss

AUTH: AJOHNSON, W.

CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVAIL. NTIS SAP: HC A03/MF A01

Sponsored in part by Army

MAJS: /DESIGN PROPULSION SYSTEMS/HELIQUETER PERFORMANCE/* OPTIMAL CONTROL/VERTICAL LANDING

MINS: / FLIGHT TESTS/ HELIQUETER DESIGN/ HOVERING/ VERTICAL FLIGHT

ABA: Author

ABS: An optimal control solution is obtained for the descent and landing of a helicopter after the loss of power in level flight. The model considers the helicopter vertical velocity, horizontal velocity, and rotor speed; and it includes representations of ground effect, rotor inflow time lag, pilot reaction time, rotor stall, and the induced velocity curve in the vortex ring state. The control (rotor thrust magnitude and direction) required to minimize the vertical and horizontal velocity at contact with the ground is obtained using nonlinear optimal control theory. It is found that the optimal descent after power loss in hover is a purely vertical flight path. Good correlation, even quantitatively, is found between the calculations and (non-optimal) flight test results.

77W25606# ISSUE 16 PAGE 2075 CATEGORY 2 RPT#: NASA-1M-x-73238 A-7071 77/05/00 158 PAGES UNCLASSIFIED DOCUMENT

UTTL: Laser velocimeter measurements of two-bladed helicopter rotor flow fields


CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVAIL. NTIS SAP: HC A03/MF A01

MAJS: /FLOW DISTRIBUTION/LASER DOPPLER VELOCIMETERS/ ROTARY WING AIRCRAFT

MINS: / FLOW MEASUREMENTS/ HELICOTHER/ MINICOMPUTERS/ WIND TUNNEL TESTS

ABA: Author

ABS: Data from a wind tunnel investigation of the flow fields around helicopter rotors were presented. A component laser velocimeter was used to measure the velocity fields of two 2.1 m diameter rotors. A minicomputer-based on-line data system is described which monitored, reduced, and plotted the results. Tip vortices constitute the primary disturbances in the flow field, but present theories do not predict vortex positions and velocity distributions with sufficient accuracy.

77A2493# ISSUE 10 PAGE 1565 CATEGORY E 77/03/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Optimal control alleviation of tilting propeller gust response

AUTH: AJOHNSON, W. PAA: A/NASA, Ames Research Center, Large Scale Aerodynamics Branch. U.S. Army Air Mobility Research and Development Laboratory, Moffett Field, Calif.)


MAJS: /AEREOELASTICITY/GUST ALLEVIATORS/OPTIMAL CONTROL/ ROTOR AERODYNAMICS/TILT ROTOR AIRCRAFT/TILTED ROTOR

MINS: / AERODYNAMIC LOADS/ AERODYNAMIC STABILITY/ CONTROL THEORY/ CONTROLLABILITY/ CONTROLLERS/ KALMAN FILTERS/ ROTOR SPED/ SYSTEMS ENGINEERING

ABA: (Admin.)

ABS: Optimal control theory is applied to the design of a control system for alleviation of the gust response of tilting propeller aircraft. Using a propeller and cantilever wing analytical model, the uncontrolled and controlled gust response is examined over the entire operating range of the aircraft except for hover.
helicopter mode, conversion, and airplane mode flight. Substantial improvements in the load, ride quality, and aerodynamic stability are possible with a properly designed controller. A single controller, nominally optimal only at the Design Point speed (160 knots here), operated efficiently over the entire speed range, with the possible exception of very low speed in helicopter mode. Kalman-Bucy filters were used as compensation networks to provide state estimates from various measurements in the system. Efficient control requires the measurement of the wing motion, rotor speed perturbation, and tip-path-plane tilt.

77A30006* ISSUE 12 PAGE 1948 CATEGORY Y 3 77/02/02 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Directions in civil aviation 1980-2000
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MAJS: /*AIR TRANSPORTATION*/AIRCRAFT DESIGN/*CIVIL AVIATION /*TECHNOLOGICAL FORECASTING
MINS: /*COMMERCIAL AIRCRAFT*/GENERAL AVIATION AIRCRAFT/ HYPERSONIC AIRCRAFT/ PASSENGER AIRCRAFT/ RESEARCH AND DEVELOPMENT/ SUBSONIC AIRCRAFT/ SUPERSONIC AIRCRAFT

ABA: B.J.

ABS: The following future directions in civil aviation are considered: (1) greater economy and efficiency in passenger and cargo air service at subsonic speeds, and improved utility and safety for general aviation. (2) greatly improved short haul air transportation using turbofan or turboprop aircraft, and subsequently, rotorcraft and V/STOL aircraft. and (3) superfast, and ultimately hypersonic, air transportation for transcontinental range flight. Attention is also given to new directions in research and technology.

79A14971* ISSUE 4 PAGE 543 CATEGORY B 77/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design and evaluation of flight directors for V/STOL aircraft
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MAJS: /*AIRCRAFT CONTROL*/COMPENSATORY TRACKING*/CONTROLERS /*OPTIMAL CONTROL*/SYSTEMS ENGINEERING/V/STOL AIRCRAFT
MINS: /*AIRCRAFT LANDING*/AIRCRAFT MAINTENANCE/*AIRCRAFT PILOTING/*AIRCRAFT DESIGN ANALYSIS/*DISPLAY DEVICES/HECTOR CONTROL/LONGITUDINAL CONTROL/PILOT PERFORMANCE/*STABILITY AUGMENTATION/TRANSFER FUNCTIONS

ABA: (Author)

ABS: A brief review of model-based techniques for the design of aircraft flight directors is undertaken. An analytical director design technique which utilizes an optimal controller model of the human pilot is then discussed in more detail. The analytical and experimental results of three specific director design studies are discussed, all involving control of a light utility helicopter. Finally, a general design methodology is discussed which can aid in the specification of pilot-centered display requirements.

77A40087+ ISSUE 18 PAGE 3003 CATEGORY R 5 RPT: 77/00/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTL: Status report on XV-15 Tilt Rotor Test Program
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.: Army Air Mobility Research and Development Laboratory, Moffett Field, Calif.

ABA: (Author)

ABS: The XV-15 Tilt Rotor Research Aircraft Program has progressed from the design and fabrication stage to the test phase and is now beginning that portion of the program which will culminate in the determination of the viability of this promising concept. This paper will review the joint Army/NASA/Bell Helicopter Testron (BHT) XV-15 program as it currently stands, including the results of the experience gained during the design and fabrication phases and testing leading to date.
Highlights of the overall Tilt Rotor Program will be
discussed exploring the potential of this concept to
result in a new generation of highly productive VTOL
systems.

77A40061# ISSUE 18 PAGE 3002 CATEGORY 5 RPT#: 
AHS 77-33-17 77/00/00 9 PAGES UNCLASSIFIED
DOCUMENT

UTTL: A review of advanced rotor research in helicopter
development

AUTH: A2KLY, M. W.; B/RABBOTT, J. P. 
FAA: A/(NASA, Ames 
Research Center, Large-Scale Aerodynamics Branch, 
Moffett Field, Calif.); B/(U.S. Army Air 
Mobility Research and Development Laboratory, Moffett Field, 
Calif.)

in: American Helicopter Society. Annual National 
Proceedings. (A77-40048 10-01) Washington, D.C., 

MAJS: /HELICOPTER DESIGN/*ROTOR WINGS/*TECHNOLOGY

MINS: /COMPOSITE STRUCTURES/*DYNAMIC LOADS/*HELIICOPTER
PERFORMANCE/*RESEARCH AND DEVELOPMENT/*VARIABLE
GEOMETRY STRUCTURES

ABA: B.J.

This paper reviews advanced-rotor concepts including
the advancing blade concept, the circulation control
rotor, the X-wing rotor, the variable diameter rotor,
the hingeless tilt rotor, the bearingless main rotor,
the composite structures rotor, the variable geometry
rotor, the multicycle controllable pitch rotor, the
multicycle controllable twist rotor, and the live
wheel rotor. The rotor concepts are discussed in terms of
performance (cruise speed and lift/drag ratio) and
dynamic loads and vibration.

77A40064# ISSUE 16 PAGE 2998 CATEGORY 2 RPT#: 
AHS 77-33-06 77/00/00 12 PAGES UNCLASSIFIED
DOCUMENT

UTTL: Measurements of helicopter rotor tip vortices

D/LEPTER, O. J. 
FAA: B/(NASA, Ames Research Center, Moffett Field, 
Calif.); C/(Team Engineering, Inc., 
Sunnyvale, Calif.); D/(U.S. Army, Air Mobility 
Research and Development Laboratory, Moffett Field, 
Calif.)

CORP: National Aeronautics and Space Administration. Ames 
Research Center, Moffett Field, Calif.; Team 
Engineering, Inc., Sunnyvale, Calif.; U.S. Army, Air Mobility 
Research and Development Laboratory, Moffett Field, Calif.

This paper presents results from a recent wind-tunnel 
investigation of model helicopter rotor tip vortices. 
Measurements were made of the vortex positions, core 
sizes, and velocity distributions. A laser velocimeter 
was used to make the measurements, and a 
minicomputer-based data system was used to process 
the data and to aid in controlling the experiment. The 
velocimeter, the data system, and the software 
developed for the minicomputer are briefly described.

The rotors investigated were two-bladed, leaning 
rotors with diameters of 2.1 m. Two sets of blades 
were used, one set with zero twist and one set with
a 11 deg of linear twist. The vortex positions were
obtained by making flow field traverses while strobing 
the data system at a fixed azimuth. Aging of a vortex 
element was also studied by following the convected 
element while strobing the data system at different 
azimuths. By this method, the effects on the vortex of 
a close interaction with a blade and another vortex 
were studied.
Interagency studies conducted during the last several years have indicated the need to improve full-scale testing capabilities. The studies showed that the most effective trade between test capability and facility cost was provided by re-powering the existing Ames Research Center 40- by 80-foot wind tunnel to increase the maximum speed from about 100 m/s (200 knots) to about 150 m/s (300 knots) and by adding a new 37-m (120-ft) test section powered for about a 50-m/s (100-knot) maximum speed. This paper reviews the design of the facility, a few of its test capabilities, and some of its unique features.
This paper presents an overview of supporting technology programs conducted to reduce the risk in the joint NASA/Navy Lift/Cruise Fan Research and Technology Aircraft Program. The aeronautical community has endeavored to combine the low-speed and lifting capabilities of the helicopter with the high-speed capabilities of the jet aircraft. Recent developments have indicated a lift/cruise fan propulsion system may provide these desired characteristics. NASA and the Navy have formulated a program that will provide a research and technology aircraft to furnish viability of the lift/cruise fan aircraft through flight experiments and obtain data on design for future naval and civil V/STOL aircraft.

The supporting technology programs discussed include: (1) design studies for operational aircraft, a research and technology aircraft, and associated propulsion systems; (2) wind-tunnel tests of several configurations; (3) propulsion-system test vectoring tests, and (4) simulation. These supporting technology programs have indicated that a satisfactory research and technology aircraft program can be accomplished within the current level of technology.

A number of applications of a rotorcraft aerelastic analysis are presented to verify that the analysis encompasses the classical solutions of rotor dynamics, and to examine the influence of certain features of the model. Results are given for the following topics: flapping, torsion response to pitch control; forward flight flapping stability; pitch/ flap flutter and divergence; ground resonance instability; and the flight dynamics of several representative helicopters.
equations are adapted for a linearized stability analysis in the hovering flight condition by prescribing aerodynamic forces, applying Galerkin's method, and linearizing the resulting ordinary differential equations about the equilibrium operating condition. The aerodynamic forces are obtained from strip theory based on a quasi-steady approximation of two-dimensional unsteady airfoil theory. Six coupled mode shapes, calculated from free vibration about the equilibrium operating condition, are used in the linearized stability analysis. The study emphasizes the effects of two types of structural coupling that strongly influence the stability of hingeless rotor blades. The first structural coupling is the linear coupling between flap and lead-lag bending of the rotor blade. The second structural coupling is a nonlinear coupling between flap bending, lead-lag bending, and torsion deflections. Results are obtained for a wide variety of hingeless rotor configurations and operating conditions in order to provide a reasonably complete picture of hingeless rotor blade stability characteristics.

7641906# ISSUE 21 PAGE 323 CATEGORY 1
7G/12/07/07 9 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/HELKS, W. P., JR.; B/ADERMO, J. R. PAA;
A/NASA, Ames Research Center, Moffett Field, Calif.; B/illumined Missiles and Space Co., Inc., Sunnyvale, Calif.)

CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MINS: /CIVIL AVIATION/MARKET RESEARCH/REMOTE PILOTTED VEHICLES/TECHNOLOGY UTILIZATION

MINS: AIRCRAFT DESIGN/REMOTE SENSORS/ROTOR WING AIRCRAFT/SURFACE VEHICLES/USER REQUIREMENTS/UTILITY AIRCRAFT

AB: Author

AB: An overview of an ongoing study of civil applications of Remotely Piloted Vehicles (RPVs) is presented, including a summation of results to date and the status of work yet to be completed. The intent of the study is to examine the total technical, economic, and environmental impact of RPVs in the civil environment in order to identify and assess the technological effort required to bring these vehicles to realization. The paper describes a market survey in which some 55 civil applications of RPVs have been
defined and categorized into groups which have similar mission requirements. From this broad analysis of many potential uses, a smaller number of promising and representative applications have been selected for more in-depth analysis. Using one or two of these applications as specific examples, the paper briefly describes system performance requirements and vehicle concepts, and compares the benefits and costs with those of present methods. The paper also reports on the status of other work such as subsystem concepts, assessment of the technology, and the influence of safety and environmental considerations on these future civil RPV systems.

76N10083# ISSUE 9 PAGE 1075 CATEGORY 3 RPT:
NASA-TM-X-73083 A-6820 75/12/00 69 PAGES
UNCLASSIFIED DOCUMENT
UTL: Benefits of VTO aircraft in offshore petroleum
logistics support
AUTH: A/WILCOX, D. E.; B/SHOVELN, M. D.
CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif. AVAIL.NTIS
SAP: HC $4.50
MAJS: /LOGISTICS MANAGEMENT/ OFFSHORE ENERGY SOURCES/
VERTICAL TAKEOFF AIRCRAFT
MINS: / AIR TRANSPORTATION/ ECONOMIC ANALYSIS/ HELICOPTER
DESIGN/ PROPULSIVE EFFICIENCY
ABA: Author
ABS: The mission suitability and potential economic benefits of advanced VTO aircraft were investigated for logistics support of petroleum operations in the North Sea and the Gulf of Mexico. Concepts such as the tilt rotor and lift/cruise fan are promising for future operations beyond 150 miles offshore, where their high cruise efficiency provides savings in trip time, fuel consumption, and capital investment. Depending upon mission requirements, the aircraft operating costs are reduced by as much as 20 percent to 50 percent from those of current helicopters.

76N10095# ISSUE 2 PAGE 131 CATEGORY 1 RPT:
NASA-TM-X-62494 A-6307 75/05/00 27 PAGES
UNCLASSIFIED DOCUMENT
UTL: Optimal control alleviation of tilting protor propeller gust response
AUTH: A/JOHNSON, W.
CORP: National Aeronautics and Space Administration, Ames
Research Center, Moffett Field, Calif.: Army Air
Mobility Research and Development Lab., Moffett Field, Calif. AVAIL.NTIS
SAP: HC $4.00
Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
MAJS: / OPTIMAL CONTROL/ TILTING ROTORS
MINS: / AERODYNAMIC LOADS/ DYNAMIC RESPONSE/ HELICOPTER
DESIGN/ ROTOR AERODYNAMICS
ABA: Author
ABS: Optimal control theory is applied to the design of a control system for alleviation of the gust response of tilting protor propeller aircraft. Using a protor and cantilever wing analytical model, the uncontrolled gust response is examined over the entire operating range of the aircraft except for hover. Helicopter mode, conversion, and airplane mode flight. Substantial improvements in the loads, ride quality, and aeroelastic stability are possible with a properly designed controller. A single controller, namely optimal only at the design point speed (160 knots here), operates efficiently over the entire speed range, with the possible exception of very low speed in helicopter mode. Kalman-Bucy filters were used as compensation networks to provide state estimates from various measurements in the wing motion, rotor speed perturbation, and tip-path-plane tilt.
A digital computer program written in FORTRAN is presented in this paper. It implements the system identification theory for deterministic systems with input-output measurements. The user supplies programs simulating the mathematical model of the physical plant whose parameters are to be identified. The user may choose any of the three options. The first option allows for a complete model simulation for fixed input forcing functions. The second option identifies up to 36 parameters of the model from wind tunnel or flight measurements. The third option performs a sensitivity analysis for up to 36 parameters. The use of each option is illustrated with an example showing input-output measurements for a helicopter rotor tested in a wind tunnel.
The design features and general characteristics of the NASA/Army XV-15 tilt rotor research aircraft are described. This aircraft was conceived as a proof-of-concept vehicle and a V/STOL research tool for integrated wind tunnel, flight simulation, and flight-test investigations. Discussions of special design provisions and safety considerations necessary to perform these missions are included in this report. In addition to predictions of aircraft and engine performance for the hover, helicopter, and airplane flight modes, analytical estimates of the structural and dynamic limitations of the XV-15 are provided.
Techniques for Improving the Stability of Soft Inplane Hingeless Rotor

AUTH: A/ORMISTON, R. A.
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MAJS: /AERODYNAMIC STABILITY/ RIGID ROTORS/ ROTOR BLADES/ VIBRATION DAMPING

MINS: /AERODYNAMIC CONFIGURATIONS/ RIGID ROTORS/ ROTOR BLADES/ VIBRATION DAMPING

ABA: Author

ABS: The influence of basic parameters that govern flap lag stability of hingeless rotor blades in hover is reviewed, and potential methods are studied for improving the lead lag damping of soft inplane configurations for low thrust conditions. These conditions are relevant for ground and air resonance stability of coupled rotor body dynamic systems. Results indicate that the isolated rotor blade lead lag damping can be usefully increased by a combination of flap lag elastic coupling and pitch lag coupling. For a typical soft inplane configuration, 6% of critical damping can be obtained for moderate pitch lag coupling. For large values of the coupling parameters, the lead lag frequency is substantially reduced at high pitch angles and airfoil stall effects also reduce the lead lag damping.
DS bulldozer and an M109 self-propelled 155 MM howitzer to determine the aerodynamic characteristics of these typical externally-suspended heavy lift helicopter cargo configurations. Tests were made over a large range of pitch and yaw attitudes at a nominal Reynolds number per unit length of 1.5 x 10 to the 6th power.

76A10454* ISSUE: PAGE 57 CATEGORY 35
74/00/00 26 PAGES UNCLASSIFIED DOCUMENT

CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.


MAUS: PA/FLUID DYNAMICS/PA/LASER APPLICATIONS/PA/VELOCITY MEASUREMENT/PA/VORTEXES/WIND TUNNEL TESTS
MINS: PA/FLOW DISTRIBUTION/PA/HELICOPTER PROPULSION DRIVE/PA/HELICOPTER EQUIPMENT/PA/OCCILLATING EQUIPMENT/PA/OSCILLATING VARIATIONS/PA/SPECTRUM ANALYSIS/PA/TRAILING EDGES/PA/TRANSMITTER RECEIVERS/PA/WATER FLOW/PA/WIND TUNNELS

ABA: (Author)

The transmitting-receiving lens system of a two-component backscatter laser-velocity optical system currently in operation is discussed. It is basically a Galilean-type telescope which provides for spatial translation of the focal volume along the optical axis, but it also has certain optical constraints which are discussed. This scanning feature of the unit has been used with spectrum analyzer processing for the measurement of (1) trailing vortices in a wind tunnel and (2) a developing (decaying) vortex that was generated by towing a wing model through a water towing tank. The optical system has also been interfaced with point-counting electronics and has been applied to the periodic flow generated by a model helicopter rotor. Results are presented and the techniques of data acquisition and the 'strobing' of the processor are discussed.

74N34494* ISSUE 24 PAGE 2502 CATEGORY 2
74/00/00 9 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/BIGGERS, J. C.
CORP: National Aeronautics and Space Administration. Ames

Research Center, Moffett Field, Calif.
In: Its Rotorcraft Dyn. p 45-53 (SEE N74-34489 24-02)
MAJS: PA/HELICOPTER STABILITY/PA/FLAPPING NOTARY WINGS
MINS: PA/HELICOPTER CONTROL/PA/MATHEMATICAL MODELS/PA/ROTOR AERODYNAMICS

ABA: Author

The flapping equation for a helicopter in forward flight are reported which have coefficients that are periodic in time, and this effect complicates the calculation of stability. A constant coefficient approximation which will allow the use of all the well developed methods for analyzing constant coefficient equations is presented. The flapping equation is first transformed into the nonrotating coordinate frame, where some of the periodic coefficients are transformed into constant terms. The constant coefficient approximation is then made by using time averaged coefficients in the nonrotating frame. Stability calculations based on the approximation are compared to results from a theory which correctly includes all of the periodicity. The comparison indicates that the approximation is reasonably accurate at advance ratios up to 0.5.

74N34489* ISSUE 24 PAGE 2901 CATEGORY 2 RPT#:
NASA-SP-357 74/00/00 370 PAGES UNCLASSIFIED DOCUMENT

UTH: Rotorcraft Dynamics
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVAIL. NTIS SAP: HC 80-60


MAJS: PA/CONFERENCES/PA/ROTOR AERODYNAMICS/PA/ROTORCRAFT AIRCRAFT
MINS: PA/DYNAMIC STRUCTURAL ANALYSIS/PA/HELICOPTERS/PA/LOADS
F(ORCES)/PA/ROTARY WINGS/VIBRATION

ANN: The dynamic structural analysis of rotary winged aircraft is reported, considering helicopter vibration and loads.

73N24987* ISSUE 15 PAGE 1838 CATEGORY 32 RPT#:
NASA-M-R-2770 A-4629 73/05/00 36 PAGES
UNCLASSIFIED DOCUMENT

UTH: Nonlinear equations for bending of rotating beams with application to linear flap-lag stability of hingeless rotors

UNOC: Numerical analysis of bending of rotating beams with application to linear flap-lag stability of hingeless rotary wings using nonlinear equations

AUTH: A/HODGES, D. H.; B/ORNSTON, R. A.
CORP: National Aeronautics and Space Administration. Ames
are shown for two representative helicopters, the UH-1H and CH-47B. The UH-1H payload increased 86.7 percent for a 50 n.m. (92.6 km) radius mission involving two out-of-ground effect (OGE) hover take-offs of 2 minutes each at 5000 ft. (1525 m) 35 C ambient conditions. The CH-47B payload increased 49.5 percent for a 50 n.m. (92.6 km) radius mission with sling loaded cargo at an outbound payload of 1500 lb. (680 kg) internal cargo on the return leg. The mission included two 4 min. OGE hovers at 6000 ft. (1830 m) 35 C. An improvement in take off performance and maximum performance climb also resulted as a consequence of the OGE hover capability and higher maximum power available.

73N14006+74 ISSUE 5 PAGE 492 CATEGORY I RPT#: NASA-TM-X-62165 72/07/12 123 PAGES UNCLASSIFIED DOCUMENT

UTT: A pertinent solution of helicopter rotor flapping stability
UNOC: Application of perturbation techniques to single blade helicopter rotor dynamics
AUTH: A/JOHNSON W. PAA: A/Army Air Mobility R&D Lab., Moffett Field, Calif.)
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVAIL.NTIS

MAUS: /HELI GEST HER/PERTURBATION THEORY/ROTARY WINGS/\ ROTOR AERODYNAMICS
NINS: /AERODYNAMIC STABILITY/EQUATIONS OF MOTION/PROBLEM SOLVING
ABA: Author
ABS: The stability of the flapping motion of a single blade of a helicopter rotor is examined using the techniques of perturbation theory. The equation of motion studied is linear, with periodic aerodynamic coefficients due to the forward speed of the rotor. Solutions are found for four cases: small and large advance ratio and small and large lock number. The perturbation techniques appropriate to each case are discussed and illustrated in the course of the analysis. The application of perturbation techniques to other problems in rotor dynamics is discussed. It is concluded that perturbation theory is a powerful mathematical technique which should prove very useful in analyzing some of the problems of helicopter dynamics.
72N27095* ISSUE 19 PAGE 2503 CATEGORY 1 RPT:
NASA-TM-X-62169 72/07/00 93 PAGES UNCLASSIFIED DOCUMENT
UTTL: Wind tunnel investigation of aerodynamic characteristics of scale models of three rectangular-shaped cargo containers carried as external stores on helicopters
UNOC: Wind tunnel tests to determine aerodynamic characteristics of rectangular shaped containers
AUTH: A/LAUD, G. H.; B/RODAN, H. M.
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVALA. NTIS
SAP: HC $6.75
Sponsord in part by AAMRD
MAJS: /AERODYNAMIC CHARACTERISTICS/ EXTERNAL STORES/ HELICOPTERS/WIND TUNNEL MODELS
MINS: /AERODYNAMIC CONFIGURATIONS/ CONTAINERS/ DATA ACQUISITION
ABA: Author
ABS: Wind tunnel tests were conducted on scale models of three rectangular-shaped cargo containers to determine the aerodynamic characteristics of these typical externally suspended helicopter cargo configurations. Tests were made over a large range of pitch and yaw attitudes at a nominal Reynolds number per unit length of 1.6 x one million. The aerodynamic data obtained from the tests are presented.

72N28010* ISSUE 17 PAGE 2235 CATEGORY 2 RPT:
NASA-TM-X-62152 CNT#: NASS-4389 72/04/00 111 PAGES UNCLASSIFIED DOCUMENT
UTTL: Feasibility study of a bidirectional jet flap device for application to helicopter rotor blades. Phase 2: Lift controller development
UNOC: Development and evaluation of variable direction deflection thruster for application to helicopter rotors based on bidirectional jet flap device
AUTH: /NOSE, R. E.; B/WYNN, T. M.; C/SWINTH, G. A.; D/REARRILL, G. L
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.; honeywell, Inc., St. Paul, Minn.; Army Air Mobility Research and Development Lab., Moffett Field, Calif. AVALA. NTIS
SAP: HC $7.75
MAJS: /HELICOPTERS/JET FLAPS/ ROTARY WINGS/ THRUST VECTOR CONTROL
MINS: /AERODYNAMIC BALANCE/ AERODYNAMIC STABILITY/ HELICOPTER CONTROL
ABA: Author
ABS: A bidirectional jet flap device called the variable deflection thruster (VDT) has been investigated for possible application to helicopter rotors. This investigation included the development and testing of a fluidic lift control system for the VDT-blade model making use of the test result that VDT-blade lift can be increased from the differential pressure at midchord. This study constitutes a long-range program to develop blown control techniques for stabilizing the higher harmonic modes of helicopter rotors. Wind tunnel tests were conducted using a three-sectioned, two-dimensional VDT-blade model having individualll controlled VDT jet flaps in each section. Steady-state tests were conducted without the fluidic lift controller (open loop) for both full-span blowing and for the model center section blowing only. Study-state tests were conducted with the center section blowing only using the fluidic lift controller (close-loop) to control the lift on the model center section. Dynamic tests were conducted using the complete model with the VDT jet in the model center section oscillating at various frequencies and also using the model center section alone on a single endplate to obtain finite-aspect-ratio effects. Fair agreement was obtained between theory and experimental results.

71N13517# ISSUE 20 PAGE 1621 CATEGORY 2 RPT:
NASA-TM-X-62601 CNT#: 721-60-1002-00-21 71/08/00 54 PAGES UNCLASSIFIED DOCUMENT
UTTL: An investigation of a full-scale advancing blade concept rotor system at high advance ratio
UNOC: Wind tunnel tests of full scale advancing blade concept rotor system at high advance ratio
AUTH: A/FALASR, M. D.; B/MC LÜND. J. L.; C/SODERMAN, P. T.; D/STROUB, R. H.
CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AVALA. NTIS
SAP: AVAIL. NTIS
PREPARED JOINTLY WITH ARMY AIR MOBILITY RES. AND DEVELOP. LAB., MOFFETT FIELD, CALIF.
MAJS: /HELICOPTERS/LIFT DRAG RATIO/ROTARY WINGS
MINS: /AERODYNAMIC STALLING/ SYSTEMS ENGINEERING/ WIND TUNNEL STABILITY TESTS

71N23779# ISSUE 12 PAGE 1651 CATEGORY 1 RPT:
NASA-TN-D-3621 A-3863 CNT#: 721-60-1002-00-21 71/04/00 39 PAGES UNCLASSIFIED DOCUMENT
UTTL: Measurements of boundary layer transition, separation and streamline direction on rotating blades
UNOC: Laminar boundary layer transition, separation and streamline direction on rotating helicopter blades
The objectives of this study are as follows: (1) application of specific technology advances to commercial STOL transportation; (2) total effect of technology advances on STOL transport aircraft gross weight, direct operating cost, and acceptance; and (3) assessment of advanced technology progress for STOL transportation in the 1980's.
PRINT 45/21-158
B2N19707*# ISSUE 10 PAGE 1394 CATEGORY 45
RPT#: NASA-TP-1969 L-14936 02/02/00 59 PAGES
UNCLASSIFIED DOCUMENT

AUTH: A/POWELL, C. A.; B/MCCURDY, D. A.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAL.NTIS SAP: HC AA41/AF AD1

MAJS: /AIRCRAFT NOISE/HELICOPTERS/NOISE TOLERANCE/* PRESSURE PULSES/PULSE RATE/ROTARY WINGS
MINS: / ACOUSTIC SIMULATION/ IMPULSES/ NOISE MEASUREMENT/ REGRESSION ANALYSIS

ABA: Author

ABS: Annoyance judgments were obtained for computer generated stimuli simulative of helicopter impulsive noise. To investigate effects of repetition rate and impulsive noise. Each of the 82 different stimuli was judged at 3 sound pressure levels by 48 subjects. Impulse repetition rates covered a range from 10 Hz to 115 Hz; crest factors covered a range from 3.2 dB to 19.3 dB. Increases in annoyance with increases in repetition rate were found which were not predicted by certain loudness or annoyance metrics which were independent of noise level. The ability to predict effects of impulsiveness varied between the noise metrics and was found to be dependent on noise level. The ability to predict the effects of impulsiveness was not generally improved by any of several proposed impulsiveness corrections. Instead, the effects of impulsiveness were found to be systematically related to the frequency content of the stimuli. A modified frequency weighting was developed which offers improved annoyance prediction.

B2A15847# ISSUE 4 PAGE 501 CATEGORY 6
01/12/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Experimental evaluation of a perspective tunnel display for three-dimensional helicopter approaches
AUTH: A/GRAHMAI, A. J.; B/FEIGHTON, J. B.; C/HARRISON, J. P.; A/Technion - Israel Institute of Technology, Haifa, Israel; C/(NASA, Langley Research Center, Flight Electronics Div., Hampton, Va.)
CORP: Technion Israel Inst. of Tech., Haifa; National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MAJS: /APPROACH INDICATORS/COMPUTER GRAPHICS/ DISPLAY DEVICES/HELICOPTER CONTROL/THREE DIMENSIONAL MOTION
MINS: /COMPUTERIZED SIMULATION/ DESCENT TRAJECTORIES/ PREDICTION ANALYSIS TECHNIQUES/ SYMBOLS/ TRAJECTORY

OPTIMIZATION

ABA: (Author)

ABS: A computer-generated perspective tunnel display for a steep and strongly curved three-dimensional helicopter approach is studied. The necessary control variables for obtaining a curved trajectory are analyzed. The effectiveness of superimposed predictor symbols is investigated, and a suitable predictor law is formulated. The theoretical considerations are validated by an extensive fixed-base simulator program. The tunnel display with a superimposed predictor symbol is shown to outperform conventional-type displays in its ability to follow a curved trajectory in the presence of gust disturbances, to enter the trajectory from an unknown position, and to monitor gusts automatically. The feasibility of the tunnel display for operation in actual flight has been demonstrated in an exploratory flight test.

B2N17671# ISSUE B PAGE 1131 CATEGORY 53 RPT#: NASA-TP-525 01/12/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: An evaluation of helicopter noise and vibration ride qualities criteria
AUTH: A/HAMROD, C. E.; B/HOLLENBAUGH, D. D.; C/CLEVENSON, S. A.; B/LEATHERWOOD, J. D.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.; Army Research and Technology Laboratories, Fort Eustis, Va.; NOSA, Langley Research Center, Hampton, Va.; Army Research and Technology Laboratories, Fort Eustis, Va.
Nov. 1981: sponsored by the American Helicopter Society

MAJS: /*AIRCRAFT NOISE/COMFORT*/CRITERIA/HELCOPERS*/
RIDING QUALITY/VIBRATION

MINS: / HUMAN FACTORS ENGINEERING/ NOISE INTENSITY/ NOISE
MEASUREMENT/ VIBRATION MEASUREMENT

ABA: T.M.

ABS: Two methods of quantifying helicopter ride quality; absorbed power for vibration only and the NASA ride
comfort model for both noise and vibration are discussed. Noise and vibration measurements were
obtained on five operational US Army helicopters. The data were converted to both absorbed power and DISC's
(discomfort units used in the NASA model) for specific
helicopters' flight conditions. Both models indicate
considerable variation in ride quality between the
five helicopters and between flight conditions within
each helicopter.

B2N14058# ISSUE 5 PAGE 576 CATEGORY 2 RPT#:
NASA-TM-B3226 81/11/00 181 PAGES UNCLASSIFIED
DOCUMENT

UTTL: A flight investigation of blade-section aerodynamics
for a helicopter main rotor having 10-64C airfoil
sections

AUTH: A/MORRIS, C. E. K., JR.

CORP: National Aeronautics and Space Administration. Langley
AO9/MF AO1

MAJS: /*AERIAL AIRFOIL PROFILES/*FLIGHT TESTS/HELCOPERS
PERFORMANCE*/ROTOR WINGS/ROTOR AERODYNAMICS

MINS: / HOVERING/ HUBS/ PRESSURE DISTRIBUTION/ TABLES (DATA)/
TEEERING/ WIND TUNNEL TESTS

ABA: A.R.H.

ABS: Pressure data at 90 percent blade radius were obtained
for a helicopter main rotor with 10-64C blade sections
during flight. Concurrent measurements are made of
vehicle flight state, performance and some rotor
loads. The test envelope included corner level flight
from about 68 to 162 knots, climb and descent, and
collective fixed maneuvers. Good agreement is shown
between some sets of airfoil pressure distributions
obtained in flight and those from two-dimensional
wind-tunnel tests or theoretical calculations.

B2N19119# ISSUE 20 PAGE 2725 CATEGORY 5 RPT#:
NASA-TM-B1951 L-14392 81/08/00 71 PAGES UNCLASSIFIED
DOCUMENT

UTTL: US and USSR Military Aircraft and Missile Aerodynamics

AUTH: A/TUTTLE, M. H.; B/MADDALON, D. V.

CORP: National Aeronautics and Space Administration. Langley
Research Center. Hampton, Va. AVAIL NTIS: SAP: HC
AO9/MF AO1

MAJS: /*AERODYNAMICS*/AIRCRAFT DESIGN*/AIRCRAFT PERFORMANCE
*/BIBLIOGRAPHIES*/MISSILE*/U.S.S.R./UNITED STATES OF
AMERICA

MINS: /ATTACK/ EMBER AIRCRAFT/ FIGHTER AIRCRAFT/
HELICOPTERS/ VERTICAL TAKEOFF AIRCRAFT

ABA: Author

ABS: The purpose of this selected bibliography (281
citations) is to list available, unclassified,
unlimited publications which provide aerodynamic data
on major aircraft and missiles currently used by the
military forces of the United States of America and
the Union of Soviet Socialist Republics. Technical
disciplines surveyed include aerodynamic performance,
static and dynamic stability, stability, spin, flutter,
buffer, inlets nozzles, flap performance, and flying
qualities. Concentration is on specific aircraft
including fighters, bombers, helicopters, missiles,
and some work on transports, which are or could be
used for military purposes. The bibliography is
limited to material published from 1970 to 1980. The
publications herein illustrate many of the types of
aerodynamic data obtained in the course of aircraft
development programs and may therefore provide some
guidance in identifying problems to be expected in the
conduct of such work. As such, this information may be
useful in planning future research programs.

B2N17697# CATEGORY 2 RPT#: NASA-TP-1864
AVRADCOM-Tk-01-B-3 L-14182 CAT#: Proj. Feed D6 Proj.
11-61102-AH-45 81/07/00 74 PAGES UNCLASSIFIED
DOCUMENT DOMESTIC

UTTL: Experimental investigation of a 10-percent-thick
helicopter rotor airfoil section designed with a
viscous transonic analysis code

AUTH: A/SODNAN, K. W.

CORP: National Aeronautics and Space Administration. Langley
tils An Early Domestic Dissemination Report): SAP:
Avail: NASA Industrial Applications Center only to
U.S. requesters: HC AO9/MF AO1

MAJS: /*AERIAL AIRFOIL PROFILES*/HELICOPTER DESIGN*/ROTOR
WINGS/*TRANSONIC SPEED*/VISCOS FLOW

MINS: /*AERODYNAMIC COEFFICIENTS*/AERODYNAMIC DRAG*/ FORCE
DISTRIBUTION/ HELICOPTER WAKES*/ PITCHING MOMENTS/
SCALE MODELS*/ STATIC PRESSURE*/ WIND TUNNEL TESTS
B1A33952© ISSUE 14 PAGE 2299 CATEGORY 5 RPT#: AHS PAPER B1-58 81/05/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Acoustic performance evaluation of an advanced UH-1 helicopter main rotor system


CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MAJS: /AIRCRAFT NOISE/HELICOPTER PERFORMANCE/NOISE MEASUREMENT/PERFORMANCE PREDICTION/ROTARY WINGS/UH-1 HELICOPTER

MIN/S: /NOISE REDUCTION/ WIND TUNNEL TESTS

ABA: [Author]

ABS: An experimental investigation of the high-speed impulsive noise characteristics of an advanced main rotor system for the UH-1 helicopter has been conducted. Modes of both the advanced main rotor system and the UH-1 main rotor system were tested at one-quarter scale in the Langley 4- by 7-meter (V/STCL) Tunnel using the General Rotor Model System (GRMS). Tests were conducted over a range of simulated flight and descent velocities. The tunnel was operated in the open-throat configuration with acoustic tricks to improve the acoustic characteristics of the test chamber. In-plane acoustic measurements of the high-speed impulsive noise demonstrated a 7 to 8 dB reduction in noise generation is available by using the advanced rotor system on the UH-1 helicopter.

B1N21027© ISSUE 12 PAGE 1575 CATEGORY 2 RPT#: NASA-TM-81556 USAVRADCOM-TR-BI-B-1 81/03/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fluid mechanics mechanisms in the stall process of helicopters

AUTH: A/YOUNG, R. H., JR.


MAJS: /AERODYNAMIC STALLING/AIR FLOW/HELICOPTER WAKES/HELICOPTERS/ROTOR AERODYNAMICS/ VORTEX SHEDDING

MIN/S: /AERODYNAMIC STALLING/AIR FLOW/HELICOPTER WAKES/HELICOPTERS/ROTOR AERODYNAMICS/ VORTEX SHEDDING

ABA: [Author]

ABS: Recent experimental results from airfoils in the Mach number, Reynolds number, or reduced frequency ranges typical of helicopter rotor blades have identified the most influential flow mechanisms in the dynamic stall process. The importance of secondary shed vortices, downstream wake action, and the flow in the separated region is generally acknowledged but poorly understood. By means of surface pressure cross-correlations and flow field measurements in static stall, several new hypotheses have been generated. It is proposed that vortex shedding may be caused by acoustic disturbances propagating forward in the lower (pressure) surface boundary layer, that sheared vortex lines form a trail of vorticity that forms a turbulent free shear layer. The known dynamic stall flow mechanisms are reviewed and the potential importance of recently proposed and hypothetical flow phenomena with respect...
to helicopter blade aerelastic response are assessed.

ABS: Phenomena that control the flow during the stall portion of a dynamic stall cycle are analyzed, and their effect on blade motion is outlined. Four mechanisms by which dynamic stall may be initiated are identified: (1) bursting of the separation bubble, (2) flow reversal in the turbulent boundary layer on the airfoil upper surface, (3) shock wave-boundary layer interaction behind the airfoil crest, and (4) acoustic wave propagation below the airfoil. The fluid mechanics that contribute to the identified flow phenomena are summarized, and the usefulness of a model that incorporates the required fluid mechanics mechanisms is discussed.

AUTH: A. HEYSON, H. H.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MINS: / AERODYNAMIC STABILITY/ GROUND EFFECT/ HELICOPTER WADES/ ROTOR AERODYNAMICS

ABA: T. M.

Wind tunnel measurements show that the wake of a rotor, except at near hovering speeds, is not like that of a propeller. The wake is more like that of a wing except that, because of the slow speeds, the wake velocities may be much greater. The helicopter can produce a wake hazard to following light aircraft that is disproporionately great compared to an equivalent fixed wing aircraft. This hazard should be recognized by both pilots and airport controllers when operating in congested areas. Ground effect is generally counted as a blessing since it allows overloaded takeoffs; however, it also introduces additional operation problems. These problems include premature blade stall in hover, settling in forward transition, shuddering in approach to touchdown and complications with yaw control. None of these problems were treated analytically in an approximate manner and reasonable experiment agreement was obtained. An awareness of these effects can prepare the user for their appearance and their consequences.
A flight investigation of performance and loads for a helicopter with MC-SC2 main rotor blade sections.

AUTH: AD/MORRIS, C. E. K., JR.; B/MAINAINE, R. L.; C/STEVENSON, D. D.

C/STEVENSON, D. D.

Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va.

MAJS: /AERODYNAMIC LOADS, AH-1G HELICOPTER /FLIGHT CHARACTERISTICS/Helicoter PERFORMANCE /ROTOR ANGLES

MINS: /FLIGHT TESTS/ HELICOPTER PROPPELLER DRIVE/ MANEUVERABILITY

ABA: T. M.

ABS: The test envelope included hover, forward-flight speeds up to 174 m/sec (65 to 162 knots), and collective fixed maneuvers at about 0.25 tip speed a. From the data set for each test point describes vehicle flight states, control positions, rotor loads, power requirements and blade motions. Rotors loads were recorded primarily in terms of peak-to-peak and harmonic content. Lower frequency components predominated for most loads and generally increased with increased airspeed, but not necessarily with increased maneuver load factor.

8ON33348# ISSUE 24 PAGE 3276 CATEGORIES 2 RPT: NASA-IA-81171 AVARDACOM-TR-80-0-E 00/10/CD 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: A flight investigation of performance and loads for a helicopter with 10.6 m main rotor blade sections.

AUTH: AD/MORRIS, C. E. K., JR.; B/MAINAINE, R. L.; C/STEVENSON, D. D.

Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va.

MAJS: /AERODYNAMIC LOADS, AH-1G HELICOPTER /FLIGHT STABILITY TESTS /HELICOPTER PERFORMANCE /ROTOR ANGLES

MINS: /AERODYNAMIC STABILITY /AIRCRAFT RELIABILITY /AIRFOIL PROFILES /TIP DRIVEN ROTORS / WING LOADING

ABA: T. M.

ABS: A flight investigation produced data on performance and load terms for a teetering rotor, AH-1G helicopter flown with a main rotor that had the NR-1.5 airfoil as the blade section contour. The test envelope included hover, forward-flight speeds up to 174 m/sec (65 to 162 knots), and collective fixed maneuvers at about 0.25 tip speed ratio. The data set for each test point describes vehicle flight states, control positions, rotor loads, power requirements, and blade motions. Rotors loads are reviewed primarily in terms of peak to peak and harmonic content. Lower frequency components predominated for most loads and generally increased with increased airspeed, but not necessarily with increased maneuver load factor. Detailes data for an advanced airfoil on an AH-1G are presented.

8ON32333# ISSUE 23 PAGE 3639 CATEGORIES 2 RPT: NASA-TP-1701 L-13139 AVARDACOM-TR-80-0-E 00/09/OG 00 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aerodynamic characteristics of three helicopter rotor airfoil sections at Reynolds number from model scale to full scale at Mach numbers from 0.35 to 0.90 -- conducted in Langley 6 by 24 inch transonic tunnel.
An investigation was conducted in the Langley 6 by 28 inch transonic tunnel to determine the two dimensional aerodynamic characteristics of three helicopter rotor airfoils at Reynolds numbers from typical model scale to full scale at Mach numbers from about 0.35 to 0.96. The model scale Reynolds numbers ranged from about 700,000 to 1,500,000 and the full scale Reynolds numbers ranged from about 3,000,000 to 6,000,000. The airfoils tested were the NASA 0012 (0 deg Tab), the SC 1095 FB, and the SC 1095. Both the SC 1095 and the SC 1095 FB airfoils had trailing edge tabs. The results of this investigation indicate that Reynolds number effects can be significant on the maximum normal force coefficient and all drag related parameters, namely, drag at zero normal force, maximum normal force, drag ratio, and drag divergence Mach number. The increments in these parameters at a given Mach number owing to the model scale to full scale Reynolds number change are different for each of the airfoils.

This paper presents a summary of NASA's propeller and helicopter noise research. The objective of this research is to develop the data required to predict propeller noise over a broad range of propeller and operating conditions. The status of current research will be described for both low- and high-speed propellers and for helicopter rotors. Recent results and future research thrusts are also discussed.
Both compact and noncompact source formulations are derived. The compact formulations are obtained as the limit of noncompact source results. In particular, the linearized acoustic equations by Hawkings and Lowson, Farassat, Hanson, Woan and Gregorek, Succi, and You are derived in this paper. An interesting thickness noise formula by Ljess and its recent extension to the near field by Brallard and Williams are also presented. The paper includes some comparisons of measured and calculated acoustic pressure signatures and spectra for an advanced propeller. The theoretical results are obtained using a computer program developed by the author and P. A. Nystrom.

80A34940# ISSUE 14 PAGE 2492 CATEGORY 5
80/60/00 31 PAGES UNCLASSIFIED DOCUMENT


MAJS: /AIRCRAFT CONSTRUCTION MATERIALS/AIRCRAFT STRUCTURES/ CARBON FIBERS/COMMERCIAL AIRCRAFT/ FIBER COMPOSITES/WINGS
MINS: /AIRFRAME MATERIALS/AVIONICS/FIGHTER AIRCRAFT/GENERAL AVIATION AIRCRAFT/HELICOPTERS/STRUCTURAL WEIGHT/ SYSTEMS ENGINEERING/UNITED STATES OF AMERICA

ABA: A.W.

ABS: It is noted that carbon composite materials are beginning to be used in commercial transports. General aviation aircraft, military fighter aircraft and helicopters due to demonstrated weight savings and potential manufacturing cost savings. Attention is given to current production applications of carbon composites which range from the secondary structures of new commercial transports to wing primary structures of fighters. Current development efforts are discussed that will lead to their future application to fuselages, as well as whole airframes. Finally, laminate constructions which vary widely, and may be relevant to avionics system design, are examined.

80W25296# ISSUE 16 PAGE 2081 CATEGORY 2 RPT#: NASA-TP-1515 AVRADCOM-TR-80-431 L-13363 80/06/00 61 PAGES UNCLASSIFIED DOCUMENT

AUTH: T /FREEZMAN, C. E.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.; Army Aviation Research and Development Command, St. Louis, Mo. AVAIL. NTIS
MARS: Preparied in cooperation with Army Aviation Research and Development Command, St. Louis, Mo.
MAJS: /COMPUTATIONAL FLUID DYNAMICS/SDS/HELICOPTER WAKES/PANEL METHOD (FLUID DYNAMICS)/ROTOR AERODYNAMICS/WIND TUNNEL TESTS
MINS: /COMPUTER PROGRAMS/FUSELAGES/PRESSURE DISTRIBUTION/VELOCITY DISTRIBUTION/WIND TUNNEL MODELS
ABA: Author

ABS: A potential flow panel method was modified to calculate the effects of a rotor wake on the time-averaged surface pressure and velocity distributions on a helicopter fuselage. The rotor-induced velocities are calculated by using a vortex-lump wake model. The calculated pressure distributions are found to compare well with experimental data obtained from tests of a wind-tunnel model.
significant degradation in residual strength of composite components. Design, inspection, and maintenance procedures have been developed; a major NASA/US industry technology program has been developed to reduce fuel consumption of commercial transport aircraft through the use of advanced composites.

Abbreviations:
- EADI: Electronic Attitude Director Indicator
- ADI: Attitude Director Indicator

Data from a preliminary experiment are presented which attempted to define a helicopter hover task that would allow the detection of objectively measured differences in fixed base/moving base simulator performance. The addition of bank, pitch, and roll movement of a ship at sea to the hover task, by means of an adaptation of a simulator g-seat, potentially fulfills the desired definition. The feasibility of g-seat substitution for platform motion can be investigated utilizing this task.

Abbreviations:
- EADI: Electronic Attitude Director Indicator
- ADI: Attitude Director Indicator
which are judged to be unique, or particularly critical, to very large aircraft. The requirements were about equally divided among the four general areas of aerodynamics, propulsion and acoustics, structures, and vehicle systems and operations. The state of technology readiness was judged to be poor to fair for slightly more than one-half of the requirements. In the classic disciplinary areas, the state of technology readiness appears to be more advanced than for vehicle systems and operations.

BON20231* ISSUE 11 PAGE 1372 CATEGORY 2 RPT#: NASA-TM-80232 80/02/00 53 PAGES UNCLASSIFIED DOCUMENT
UTIL: Operational implications of some NASA/NASA rotary wing induced velocity studies
AUTH: A/HEYSON, H. H.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A04/MF A01
MAJS: /AIRCRAFT SAFETY/FLOW DISTRIBUTION/FLOW VELOCITY/HelicOpTER WAKES
MINS: /AIRCRAFT ACCIDENTS/AIRSPEED/AUTORotation/GROUNd EFFECT (AERODYNAMICS)/MOMENTUM THEORY
ABA: R.E.S.
ABS: Wind tunnel measurements show that the wake of a rotor, except at near-hovering speeds, is not like that of a propeller. The wake is more like that of a wing except that, because of the slow speeds, the wake velocities may be much greater. The helicopter can produce a wake hazard to following light aircraft that is disproportionately great compared to an equivalent fixed-wing aircraft. This hazard should be recognized by both pilots and airport controllers when operating in congested areas. Even simple momentum theory shows that, in autorotation and partial-power descent, the required power is a complex function of both airspeed and descent angle. The nonlinear characteristics of the aircraft together with an almost total lack of usable instrumentation at low airspeeds, has led to numerous power-settling accidents. The same theory shows that there is a minimum forward speed at which a rotor can autorotate. Neglect of, or inadequate appraisal of this minimum speed has also led to numerous accidents. Ground effect and the problems it creates is discussed.

8146352* ISSUE 22 PAGE 3913 CATEGORY 71 80/00/00 30 PAGES UNCLASSIFIED DOCUMENT
UTIL: Aircraft noise control in the 1980's
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAJS: /AIRCRAFT NOISE/ENGINE NOISE/JET AIRCRAFT NOISE/*
NOISE REDUCTION/SONIC BOOMS
MINS: AIRCRAFT ENGINES/GENERAL AVIATION AIRCRAFT/GOVERNMENT/INDUSTRY RELATIONS/HELICOPTERS/NOISE POLLUTION/SUBSONIC AIRCRAFT/SUPERSONIC AIRCRAFT
ABA: G.R.

ABS: It is pointed out that a need exists for the orderly development of technology and engineering methods for noise control of all types of aircraft. The nature and scope of aircraft noise problems are reviewed, and a description is provided of noise control progress made to date. The most serious aircraft noise problems confronting communities in the past two decades have been associated with the subsonic air carrier jet transport. Operational trends related to traffic growth and operational constraints are examined, and noise level trends are considered, taking into account engine cycle development, role of Federal noise certification, future noise exposures, and multiple noise sources. Advanced source noise reduction technology developments are discussed along with a noise impact assessment, and advanced operating procedures. Attention is also given to engine noise and sonic boom exposures in connection with supersonic air carrier aircraft, and exterior and interior noise control related to propeller/rotor aircraft.

B1A42436-4 ISSUE 19 PAGE 3254 CATEGORY 1 80/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTIL: Recommendations for the NASA Avionics program for the 1980's

AUTH: A/SPITZER, C. R.; B/BRUHNER, E. A.; C/JONES, W. R.
PAA: C/NASA, Langley Research Center, Avionics Planning Office, Hampton, VA

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MAJS: /AIRCRAFT CONTROL/AVIATION/HUMAN FACTORS ENGINEERING/MICROELECTRONICS/NASA PROGRAMS

MINS: /COMMERCIAL AIRCRAFT/GENERAL AVIATION AIRCRAFT/ROTOR WING AIRCRAFT/SYSTEMS INTEGRATION/TECHNOLOGICAL FORECASTING/V/S/STOL AIRCRAFT

ABA: G.R.

ABS: NASA is examining the merits of a significant expansion of its avionics, controls, and human factors technology program for the 1980's. The rationale for an expanded program is related to two factors. One factor is related to a utilization of recent and anticipated significant advances in microelectronics. The second factor is the need to develop new concepts in avionics and control systems for more efficient aircraft operation and better utilization of extremely limited airport capacity. Substantial benefits could be realized in the following three areas, including improved aircraft efficiency, improved flight operations, and improved/extended operational capability. The NASA Avionics, Controls, and Human Factors Technology Plan is the report of a task force of agency personnel working in close cooperation with industry, DOD, and FAA. Attention is given to the NASA role, aircraft controls, crew station technology, flight management, integration and interfacing, commercial transports, general aviation, rotorcraft, V/S/STOL, and high performance aircraft.
ABSTRACT

Existing prediction techniques are compiled and described. The descriptions include input and output parameter lists, required equations and graphs, and the range of validity for each part of the prediction procedures. Examples are provided illustrating the analysis procedure and the degree of agreement with experimental results.

ABSTRACT

Evaluation of helicopter noise due to a blade-vortex interaction for five tip configurations--conducted in the Langley V/STOL tunnel.

ABSTRACT

Ride quality criteria for noise, vibration, and their combination in the helicopter cabin environment are discussed. Results are presented of laboratory and field studies of passenger responses to interior noise and vibration during the performance of a listening task and during reverie, as well as to the interaction of noise with multi-frequency and multi-axis vibration. A study of means for reducing helicopter interior noise based on analytical, experimental and flight studies of the near-field source characteristics of the aircraft, the transmission of noise through aircraft structures and the attenuation of noise by various noise control treatments is then presented which has resulted in a reduction of 3 dB in the helicopter cabin noise. Finally, a model under development to evaluate passenger acceptance of a helicopter noise and vibration environment is included. This includes the observed noise and vibration effects on comfort and is expected to provide insights for more effective noise and vibration control.

ABSTRACT

The effect of tip shape modification on blade vortex interaction-induced helicopter blade slap noise was investigated. Simulated flight and descent velocities which have been shown to produce blade slap were tested. Aerodynamic performance parameters of the rotor system were monitored to ensure properly matched flight conditions among the tip shapes. The tunnel was operated in the tip/radial-thrust configuration with treatment to improve the acoustic characteristics of the test chamber. Four promising tips were used along with a standard square tip as a baseline configuration. A detailed acoustic evaluation on the same rotor system of the relative applicability of the various tip configurations for blade slap noise reduction is provided.
The effects of helicopter interior noise on passenger annoyance were studied. Both reverberant and listening situations were studied as well as the relative effectiveness of several descriptors (i.e., overall sound pressure level, A-weighted sound pressure level, and speech interference level) for quantifying annoyance response for these situations. The noise stimuli were based upon recordings of the interior noise of a civil helicopter research aircraft. These noises were presented at levels ranging from approximately 68 to 86 dBA with various gear clash tones selectively attenuated to give a range of spectra. Results indicated that annoyance during a listening condition is generally higher than annoyance during a reverberant condition for corresponding interior noise environments. Attenuation of the planetary gear clash tone results in increases in listening performance but has negligible effect upon annoyance for a given noise level. The noise descriptor most effective for estimating annoyance response under conditions of reverberant and listening situations is shown to be the A-weighted sound pressure level.

Simulation facility hardware and software, and presents typical simulation data to illustrate the type of data analysis carried out during software development. Finally, flight data for a later version of the autoland system are presented to demonstrate the simulation's capability to predict overall system behavior.

79N27097* ISSUE 1B PAGE 235B CATEGORY 2 RPT#: NASA-TM-B0112 79/06/00 114 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/MORRIS, C. E. K., JR.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A06/MF A01

Sponsored in part by the US Army Aviation Research and Development Command, Hampton, Va.

MAUS: /AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
MINS: DATA REDUCTION/GRAPHS (CHARTS)/IN-FLIGHT MONITORING/ROTARY WINGS/TABLES (DATA)
ABA: Author
ABS: Flight data were obtained with an instrumented AH-16 helicopter having uninstrumented, standard main rotor blades. The data are presented as the analysis of data taken when the same vehicle was flown with instrumented main rotor blades built in with new airfoils. Test results include: data on performance, flight state parameters, pitch link loads and blade amplitudes for level flight, descending turns and pull-ups. Flight test procedures and the effects of both trim variations and transient phenomena on the data are discussed.

79N26782* ISSUE 17 PAGE 2316 CATEGORY 53 RPT#: NASA-TM-B0106 79/06/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CLEVENSON, S. A.; B/LEATHERCUT, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A02/MF A01


MAUS: /AIRCRAFT NOISE/HELICOPTERS/HUMAN TOLERANCES
MINS: AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
ABA: Author
ABS: The effects of helicopter interior noise on passenger

79N26782* ISSUE 17 PAGE 2316 CATEGORY 53 RPT#: NASA-TM-B0106 79/06/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CLEVENSON, S. A.; B/LEATHERCUT, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A02/MF A01


MAUS: /AIRCRAFT NOISE/HELICOPTERS/HUMAN TOLERANCES
MINS: AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
ABA: Author
ABS: The effects of helicopter interior noise on passenger

79N26782* ISSUE 17 PAGE 2316 CATEGORY 53 RPT#: NASA-TM-B0106 79/06/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CLEVENSON, S. A.; B/LEATHERCUT, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A02/MF A01


MAUS: /AIRCRAFT NOISE/HELICOPTERS/HUMAN TOLERANCES
MINS: AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
ABA: Author
ABS: The effects of helicopter interior noise on passenger

79N26782* ISSUE 17 PAGE 2316 CATEGORY 53 RPT#: NASA-TM-B0106 79/06/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CLEVENSON, S. A.; B/LEATHERCUT, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A02/MF A01


MAUS: /AIRCRAFT NOISE/HELICOPTERS/HUMAN TOLERANCES
MINS: AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
ABA: Author
ABS: The effects of helicopter interior noise on passenger

79N26782* ISSUE 17 PAGE 2316 CATEGORY 53 RPT#: NASA-TM-B0106 79/06/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/CLEVENSON, S. A.; B/LEATHERCUT, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A02/MF A01


MAUS: /AIRCRAFT NOISE/HELICOPTERS/HUMAN TOLERANCES
MINS: AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/HELIHOST PERFORMANCE/MILITARY HELICOPTERS/ROTOR AERODYNAMICS/TEERING
ABA: Author
ABS: The effects of helicopter interior noise on passenger
annoyance for both reverie and listening situations was investigated. The relative effectiveness of several metrics for quantifying annoyance response for these situations was also studied. The noise stimuli were based upon recordings of the interior noise of civil helicopter research aircraft. These noises were presented at levels ranging from approximately 70 to 86 dB with various tonal components selectively attenuated to give a range of spectra. The listening task required the subjects to listen to and record phonetically-balanced words presented within the various noise environments. Results indicate that annoyance during a listening condition is generally higher than annoyance under a reverie condition for corresponding interior noise environments. Attenuation of the tonal components results in increases in listening performance but has only a small effect upon annoyance for a given noise level.

Original quality: Poor

OA/923060 Issue 14 Page 1105 Category 6 RPT:
NASA TM-100969 L-12505 79/05/00 16 PAGES
UNCLASSIFIED DOCUMENT

UTL: Comparison of electromechanical and cathode-ray tube display mediums for an instrument approach display.
AUTH: A/ABBOTT, T. S.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVALNTIS SAP: NC A02/AC 401
MAJS: /CATHODE RAY TUBES/ DISPLAY DEVICES/ ELECTROMECHANICAL DEVICES/FLIGHT INSTRUMENTS
MINS: /COLOR/ DIMENSIONS/ FLIGHT SIMULATION/ FLIGHT TESTS/ HELICOPTERS/ PILOT PERFORMANCE. QUALITATIVE ANALYSIS
ABA: S.E.S.

ABSTRACT: The effect on pilot performance of replacing a single electromechanical display with similar cathode-ray tube displays was studied. The effects of dimensionality, color, and grouping were evaluated with respect to the pilot's ability to interpret and respond to displayed information.

OA/943947 Issue 22 Page 4178 Category 43
79/04/00 14 PAGES UNCLASSIFIED DOCUMENT

UTL: Remote sensing of phytoplankton density and diversity in Narragansett Bay using an airborne fluorescence sensor.
AUTH: A/FARMER, F. H.; B/BROWN, C. A., JR.; C/JARRETT, O., JR.; D/CAMPBELL, J. W.; E/EERSTEIN, W. L.; P/PAJERI, E/(NASA, Langley Research Center, Hampton, Va.)

MAJS: /*AIRCRAFT EQUIPMENT/ ✔BAYS (TOPOGRAPHIC FEATURES)/ ✔CATHODE RAY TUBES/ DENSITY MEASUREMENT/ ✔FLUORESCENCE/ ✔PLANKTON/ ✔REMOTE SENSORS
MINS: /*ALGAE/ CHLOROPHYLLS/ ✔DYE LASERS/ ✔HELICOPTERS/ ✔RHODE ISLAND/ ✔SEA-TRY/ ✔SYNOPTIC MEASUREMENT/ ✔VARIATIONS/ ✔WATER POLLUTION/ ✔WATER RESOURCES
ABA: C.F.W.

ABSTRACT: An aircraft-borne remote system is presented that utilizes narrow-band light from multiple dye lasers to excite selected algae photopigments and then measures the resultant fluorescence emitted from chlorophyll a at 685 nm. Tests were conducted with both pure and mixed cultures of marine algae from a series of field tests taken from sites and bridges of Narragansett Bay, and a protective remote fluorescent sensor was flown over the bay during the 1978 winter-spring diatom bloom. Remote fluorescence observed at rover points over sea-try stations showed a correlation with in situ fluorescence, total chlorophyll, and cell count. It was concluded that the ratio of remote
fluorescence to direct chlorophyll concentration was less variable than expected, and the distribution of total chlorophyll a between two major photoplankton color groups showed three distinct areas, within the Bay, of green and golden-brown species.

**79N23754# ISSUE 14 PAGE 1902 CATEGORY 71**
**RPT#: NASA-TM-80004 79/04/00 16 PAGES**
**UNCLASSIFIED DOCUMENT**

**UTTL:** Physical and subjective studies of aircraft interior noise and vibration

**AUTH:** A/STEVENS, D. G.; B/LEATHERWOOD, J. D.

**CORP:** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**AVAIL:** NTIS SAP: HC A02/XF A01

To be presented at Symp. on Internal Noise in Helicopters, Southampton, England, 17-20 July 1979

**MAJS:** /AIRCRAFT COMPARTMENTS/*NOISE TOLERANCE/*PASSENGERS/*

**MINS:** /AIRCRAFT NOISE/AUDITORY STIMULI/COMFORT/

**A3A:** HELICOPTERS/NOISE REDUCTION/VIBRATION DAMPING

**A.R.H.:**

**ABS:** Measurements to define and quantify the interior noise and vibration stimulation of aircraft are reviewed as well as field and simulation studies to determine the subjective response to such stimuli, and theoretical and experimental studies to control the interior environment. In addition, ride quality criteria standards for noise, vibration, and combinations of these stimuli are discussed in relation to the helicopter cabin environment. Data on passenger response are presented to illustrate the effects of interior noise and vibration on speech intelligibility and comfort of crew and passengers. The interactive effects of noise with multifrequency and multiaxis vibration are illustrated by data from an alternate quality simulator. Conventional and subjective measures for various combinations of noise and vibration are presented and the incorporation of these results into a user-oriented model are discussed. With respect to aircraft interior noise and vibration control ongoing studies to define the nature of noise, the transmission of noise through the structure, and the effectiveness of control treatments are described.

**79N24558# ISSUE 16 PAGE 2070 CATEGORY 2 RPT#: NASA-CASE-LAR-12396-1 US-PATENT-APPL-9N-017889 79/03/06 21 PAGES UNCLASSIFIED DOCUMENT**

**UTTL:** Helicopter rotor airfoil ILSA: Patent Application

**AUTH:** A/BINGHAM, G. J. PAT: A/inventor (to NASA)

**CORP:** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**AVAIL:** NTIS SAP: HC A02/XF A01

**MAJS:** /AIRCRAFT DESIGN/HOPEN/ROTOR WINGS/ROTOR BLADES (TURBOMACHINERY)

**MINS:** /AERODYNAMIC COEFFICIENTS/AIRCRAFT PERFORMANCE/

**ABA:** NASA

**ABS:** An airfoil which has particular application to the blades or blades of rotor aircraft and propellers of helicopter. The airfoil thickness distribution, camber and leading edge radius are shaped to locate the airfoil crest at a more aft position along the chord, and to increase the freestream Mach number at which sonic flow is attained at the airfoil root. The reduced slope of the airfoil causes a reduction in velocity at the airfoil crest and at the designed maximum lift coefficient is limited to about 0.48 when the Mach number normal to the leading edge is approximately 0.20. The lower surface leading edge radius is shaped so that the maximum local Mach number at the leading edge is limited to about 0.29 when the Mach number normal to the leading edge is approximately 0.20. The drag divergence Mach number associated with the airfoil is modified by the Mach number, and the effect on the lift coefficient resulting in superior aircraft performance.

**79A26876# ISSUE 10 PAGE 1677 CATEGORY 71**

**RPT#: AIAA PAPER 79-0606 CNT#: NSG-1474 79/03/00 10 PAGES**

**UNCLASSIFIED DOCUMENT**

**UTTL:** A comparison of linear acoustic theory with experimental noise data for a small-scale hovering aircraft

**AUTH:** A/FARQUAH, F.; B/BORRIS, C. E., Jr.; C/STROM, P. A. FAA; A/(Joint Institute for Advancement of Flight Sciences, Hampton, Va.); B/(NASA, Langley Research Center, Hampton, Va.); C/(NASA, Langley Research Center, Hampton, Va.)

**CORP:** Joint Inst. for Advancement of Flight Sciences, Hampton, Va.

**MAJS:** /AERODYNAMICS/AERODYNAMIC NOISE/AIRCRAFT NOISE/

**MINS:** /AERODYNAMIC COEFFICIENTS/AIRCRAFT PERFORMANCE/ROTOR WINGS/SCALE MODELS/SOUND FIELD
ABA: S. D.
ABS: Linear acoustic calculations based on full aerodynamic data as input are presented and compared with measured cases reported by Boxwell et al. (1978). The full aerodynamic data are obtained using three programs giving radial loading, chordwise loading, and chordwise position of transition. It is shown that in the theoretical results the most significant noise source mechanism is due to blade thickness. Thus, the conclusions of Boxwell et al. as to the importance of nonlinearities around the blades are upheld. These conclusions concern the aspect length, shape, and level of the acoustic pressure calculated from linear acoustic theory. Some of the approximations involved in the application of acoustic analogy using quadrupole sources are discussed. It is necessary that the near-field problems of rotating blades be treated together as shown for the case of an oscillating sphere.

79M26015# ISSUE 17 PAGE 2216 CATEGORY 2 RPT#: NASA-TM-80051 79/03/00 170 PAGES UNCLASSIFIED DOCUMENT
UTTL: Fuselage surface pressure measurements of a helicopter wind-tunnel model with a 3.15-meter diameter single rotor
AUTH: A/FREEMAN, C. E.; B/MINECK, R. E.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A08/MF A01
MAJS: */FUSELAGES/*HELICOPTERS/*PRESSURE MEASUREMENT
MINS: */ROTARY WINGS/*WIND TUNNEL MODELS/*WIND TUNNEL TESTS
ABA: Author
ABS: A wind-tunnel investigation was conducted to measure the time averaged fuselage surface pressures of a helicopter model with a 3.15 meter diameter, four-bladed articulated rotor. Measurements were made at hover and advance ratios of 0.05, 0.15, and 0.20 for a range of thrusts. Data are presented with no analysis.

79N15970# ISSUE 7 PAGE 620 CATEGORY 6 RPT#: NASA-TP-1397 L-11836 79/01/00 35 PAGES UNCLASSIFIED DOCUMENT
UTTL: Design and analysis of an active jet control system for helicopter sling loads
TLSP: M.S. Thesis - Old Dominion Univ
AUTH: A/PARDUE, W. D.; B/SHAUGHNESSY, J. D.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC AG03/AF A01
MAJS: */HELICOPTERS/*JET CONTROL/*MATERIALS HANDLING

TERMINAL 20 PAGE 15 (ITEMS 46-48 OF 159)
largely to this approach, the RSRA became the first helicopter system to contain a fully qualified and operational in-flight escape system.

TYPES OF AERIAL APPLICATIONS

79A33626* ISSUE 13 PAGE 2326 CATEGORY 3
79/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTL: Helicopter emergency escape
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MAUS: /DESIGN ANALYSIS/ESCAPE SYSTEMS/HELICOPTER PERFORMANCE/ROTOR SYSTEMS RESEARCH AIRCRAFT/
MINS: /Egress/Flight SAFETY/LONGITUDINAL CONTROL/ SLEDS
ABA: (Author)

ABSTRACT
The three-man Rotor Systems Research Aircraft (RSRA) Emergency Escape System, the first system known to be fully qualified and operational in a rotary wing aircraft, will have two modes of operation: one providing for full in-flight egress, and the other for the severance of the rotor blades for a return to base as a fixed-wing aircraft. This paper describes the escape system's design principles, integration into the aircraft, qualification, and performance.

BON21283* ISSUE 12 PAGE 1514 CATEGORY 2

79A11550* ISSUE 1 PAGE 7 CATEGORY 3
78/09/00 13 PAGES UNCLASSIFIED DOCUMENT

UTL: Advanced technology airfoil research. volume 2 ---

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: MC-A12/1N1 A01
Presented at conf., Langley Research Center, Hampton, Va., 7-9 Mar. 1978

MAUS: /AIRFOILS/CONFERENCE/T EchoLOGY ASSESSMENT/TECHNOLOGY UTILIZATION
MINS: /AERODYNAMIC CHARACTERISTICS/COMPUTERIZED DESIGN/GENERAL AVIATION AIRCRAFT/ROTOR WING AIRCRAFT/STRUCTURAL DESIGN/SYSTEMS ENGINEERING/TEST FACILITIES
ABA: R.E.S.

ABSTRACT
A comprehensive review of airfoil research is presented. The major thrust of the research is in three areas: development of computational aerodynamic codes for airfoil analysis and design, development of experimental facilities and test techniques, and all
'developed' and are likely to become far more important to the world's civil aviation industry. Developing countries will be increasingly important buyers of conventional subsonic long-haul jet passenger aircraft but not to the point of significant influence on the design or technological content of future aircraft of this type. However, the technological content of more specialized aircraft may be influenced by developing country requirements and reflected in designs which provide a need concerning specialized missions, related to short-haul, low-density, rough runways, and natural resource development.

78A46245-9# ISSUE 20 PAGE 3607 CATEGORY 5
78/09/00 14 PAGES UNCLASSIFIED DOCUMENT

UTILT: VALT parameter identification flight test --- VTOL Approach and Landing Technology
AUTH: A/POMINE, R. L.; B/BRYANT, W. H.; C/HODGE, W. F.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. (C/INASA, Langley Research Center, Hampton, Va.)

MAJS: /AIRCRAFT LANDING/APPRAOD/FLIGHT TESTS/
MINS: /AIRCRAFT NOISE/NOISE REDUCTION/

ABA: P.T.

ABS: The paper describes a method of establishing the accuracy of previously developed analytical models of research vehicles for a program for developing avionics technology for VTOL aircraft. The research vehicle is a Boeing-Vertol CH-47 tandem rotor transport helicopter equipped with a fly-by-wire control system. The specialized flight test was designed to take into account the presence of winds at flight conditions from hover through transition to cruise. The test provided data to obtain estimates of derivatives by parameter identification.

79N10863-9# ISSUE 1 PAGE 114 CATEGORY 71
78/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UTILT: Trends in Langley helicopter noise research
AUTH: A/HUBBARD, H. H.; B/MAGLIERTI, D. J.; C/STEPHENS, D. G.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MAJS: /AIRCRAFT NOISE/HELIICOPTERS/NOISE REDUCTION/
MINS: /AIRCRAFT COMPARTMENTS/CIVIL AVIATION/ENVIRONMENT EFFECTS/NASA PROGRAMS/PASSENGER AIRCRAFT

ABA: J.M.S.

ABS: A broad perspective of noise in helicopter exterior and interior control is presented. Emphasis is given to those items which support noise certification of civil helicopters and which result in reduced environmental noise impact to community residents as well as helicopter personnel. The activities described are related to the Langley responsibilities for helicopter acoustics as defined by NASA rules and missions.
PSYCHOACOUSTICS/*ROTARY WINGS
MINS: /CORRECTION/EFFECTIVE PERCEIVED NOISE LEVELS/HUMAN REACTIONS/HUMAN TOLERANCES/IMPULSES/SOUND PRESSURE/STATISTICAL CORRELATION
ABA: J.M.S.
ABS: The effects of several characteristics of blade slap noise on annoyance response were studied. These characteristics or parameters were the sound pressure level of the continuous noise used to simulate helicopter broadband noise, the ratio of impulse peak to broadband noise or crest factor, the number of pressure excursions comprising an impulse event, the rise and fall time of the individual impulses, and the repetition frequency of the impulses. Analyses were conducted to determine the correlation between subjective response and various physical measures for the range of parameters studied. A small but significant improvement in the predictive ability of PNL was provided by an A-weighted crest factor correlation. No significant improvement in predictive ability was provided by a rate correction.

78N10043# ISSUE 1 PAGE 112 CATEGORY 71 RPT#: NASA-CP-2052-PT-2 L-12339-PT-2 78/08/00 438 PAGES UNCLASSIFIED DOCUMENT
UTIL: Helicopter Acoustics, part 2 --- conferences
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A17/MF AO1
MAJS: /AEROACOUSTICS/*AIRCRAFT NOISE/*CONFERENCE/AIRCRAFT NOISE/*CONFERENCE/HELIPICTERS
MINS: /AUDITORY FATIGUE/HUMAN FACTORS ENGINEERING/NOISE REDUCTION/PREDICTION ANALYSIS TECHNIQUES/ROTARY WINGS/ROTOR AERODYNAMICS
ANN: Exterior and interior helicopter noise problems are addressed from the physics and engineering aspects as well as from the human factors point of view. Noise regulation concepts, human factors and criteria, rotor noise generation and control, design, operations and testing for noise control, helicopter noise prediction, and research tools and measurements are covered. For individual titles, see N79-1C844 through N79-10864.

78N3283# ISSUE 23 PAGE 330 CATEGORY 71 78/08/00 32 PAGES UNCLASSIFIED DOCUMENT
UTIL: Full-scale testing of an Ogee tip rotor --- in the Langley wind tunnel
AUTH: A/MAHATY, W. R.; B/CAMPBELL, R. L.; C/SHIDLER, P. A.
PAAS: A/(AVRADCOM Res. and Technol. Labs.)
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS SAP: HC A17/MF AO1
In its Helicopter Acoustics p 277-308 (SEE N78-32916 23-71)
MAJS: /AIRCRAFT NOISE/BLADE TIPS/HELICOTERS/OGEE SHAPE/ROTARY WINGS/ WING TIPS
MINS: /AEROACOUSTICS/NOISE POLLUTION/NOISE REDUCTION/ POLLUTION CONTROL/ROTOR AERODYNAMICS/VORTEX
ABA: J.M.S.
ABS: Full scale tests were utilized to investigate the effect of the ogee tip on helicopter rotor acoustics, performance, and loads. Two facilities were used: the Langley wind tunnel and a UH-1H helicopter. The text matrix is divided by the wind tunnel involved thrust values from 0 to 14 400 N (10.500 lb) at several tip Mach numbers for both the standard and ogee rotors. The full scale testing on the UH-1H encompassed the major portion of the flight envelopes for that aircraft. Both near field acoustic measurements and far field flyover data were obtained for both the ogee and standard rotors. Data analysis of the whirl test shows that the ogee tip does significantly diffuse the tip vortex while providing some improvement in hover performance at low and moderate thrust coefficients. Flight testing of both rotors indicates that the impulsive noise signature of the standard rotor can be reduced with the ogee rotor. Analysis of the spectra indicates a reduction in energy in the 250 Hz and 1000 Hz range for the ogee rotor. Forward flight performance was significantly improved with the ogee configuration for a large number of flight conditions. Further, rotor control loads were reduced through use of this advanced tip rotor.
the main rotor considered include repositioning of the tail rotor with respect to the main rotor, changes in the rotational direction of the tail rotor, and modification of the main rotor tip vortex. A variable geometry model was built which had the capability of varying tail rotor position relative to the main rotor as well as direction of tail rotor rotation. Acoustic data taken from the model in the Langley anechoic noise facility indicates interaction effects due to both main rotor shed vortex and the main rotor turbulence.

78N332026+  ISSUE 23  PAGE 3137  CATEGORY 71
78/08/00  24 PAGES  UNCLASSIFIED DOCUMENT

UTUL: Helicopter noise research at the Langley V/STOL tunnel

and Technol. Labs.)

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.  AVAIL.NTIS  SAP: HC
A17/MF A01

In its Helicopter Acoustics p 181-204 (see N78-32316 23-71)

MAJS: /*AIRCRAFT NOISE/*HELICOPTERS/*V/STOL AIRCRAFT/*WIND
TUNNEL TESTS

MINS: /AERODYNAMIC CONFIGURATIONS/FLIGHT TESTS/NOISE
POLLUTION/NOISE REDUCTION/POLLUTION CONTROL

ABA: J.N.S.

ABS: The noise generated from a 1/4-scale AH-1G helicopter
configuration was investigated in the Langley V/STOL
development. Microphones were installed in positions scaled
to those for which flight test data were available.
Model and tunnel conditions were carefully set to properly scale these conditions. Data presented
indicate a high degree of similarity between model and flight test results. It was found that the pressure
time history waveforms are very much alike in shape and amplitude. Blade slap when it occurred seemed to
be generated in about the same location in the rotor disk as on the flight vehicle. If model and tunnel
conditions were properly matched, including inflow turbulence characteristics, the intensity of the
Blade-slap impulse seemed to correlate well with flight.

78N332026+  ISSUE 23  PAGE 3136  CATEGORY 71
RPT#: NASA-CP-2052-P1-1 L-12345  78/08/00  399 PAGES
UNCLASSIFIED DOCUMENT

UTUL: Helicopter Acoustics

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.  AVAIL.NTIS  SAP: HC
A17/MF A01

Presented at the Intern. Specialists Symp., Hampton.
An existing computer program, used for predicting the natural frequencies and mode shapes of helicopter propeller blades, was refined to improve program accuracy and versatility. The program is based on the Holzer-Mykland approach adapted for rotating beams. Coupled vertical (out-of-plane), horizontal (in-plane), and torsional mode characteristics were determined for a variety of hub and blade configurations. The resulting program is documented by presenting the recursion equations and techniques for determining natural frequencies and mode shapes, input data requirements, and descriptions of various program outputs. The accuracy of the program is demonstrated by comparing computed results with exact solutions to classical problems and experimental data.

78N02860D+ ISSUE 19 PAGE 2567 CATEGORY 45 RPT#: NASA-TM-7875B 78/07/00 38 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/POWELL, C. A.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVALANTIS SAP: NC AOS/DF AD
MAJS: / AERODYNAMIC CONFIGURATIONS/ HULL/ ROTARY WINGS/ VIBRATION MODE

An investigation was undertaken to determine the effectiveness of four analytical methods (empirical, modified empirical, vertex-lattice, and an inviscid, three-dimensional, potential flow, wing-body program) to estimate the lateral and longitudinal stability characteristics of an isolated V-tail wind tunnel model. The experimental tests were conducted in the VSTOL tunnel at a Mach number of 0.18.

Angle-of-attack data were obtained from 0-12 deg at 0 deg sideslip. Sideslip sweep rates from 0 deg to 10 deg were made at angles of attack of 1 deg. 0 deg, and -4 deg. The V-tail dihedral angles were 45 deg, 50 deg, 55 deg, and 60 deg.

78N02860D+ ISSUE 19 PAGE 2567 CATEGORY 45 RPT#: NASA-TM-7875B 78/07/00 38 PAGES UNCLASSIFIED DOCUMENT

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVALANTIS SAP: HC A02/DF AD
MAJS: / AERODYNAMIC CHARACTERISTICS/ LATERAL STABILITY/ STATIC STABILITY/ WIND TUNNEL MODELS

An existing computer program, used for predicting the natural frequencies and mode shapes of helicopter propeller blades, was refined to improve program accuracy and versatility. The program is based on the Holzer-Mykland approach adapted for rotating beams. Coupled vertical (out-of-plane), horizontal (in-plane), and torsional mode characteristics were determined for a variety of hub and blade configurations. The resulting program is documented by presenting the recursion equations and techniques for determining natural frequencies and mode shapes, input data requirements, and descriptions of various program outputs. The accuracy of the program is demonstrated by comparing computed results with exact solutions to classical problems and experimental data.

78N02860D+ ISSUE 19 PAGE 2567 CATEGORY 45 RPT#: NASA-TM-7875B 78/07/00 38 PAGES UNCLASSIFIED DOCUMENT

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVALANTIS SAP: HC A02/DF AD
MAJS: / AERODYNAMIC CHARACTERISTICS/ LATERAL STABILITY/ STATIC STABILITY/ WIND TUNNEL MODES

An investigation was undertaken to determine the effectiveness of four analytical methods (empirical, modified empirical, vertex-lattice, and an inviscid, three-dimensional, potential flow, wing-body program) to estimate the lateral and longitudinal stability characteristics of an isolated V-tail wind tunnel model. The experimental tests were conducted in the VSTOL tunnel at a Mach number of 0.18.
Illustrate the sensitivity of rotor angular acceleration to changes in rotor lift, propulsive force, tip speed, and forward velocity.

78N27084** ISSUE 18 PAGE 2348 CATEGORY 2 RPT#: NASA: TM-78705 78/06/00 05 PAGES UNCLASSIFIED DOCUMENT

UTL: Aerodynamic characteristics of a counter-rotating, coaxial, hingeless rotor helicopter model with auxiliary propulsion

AUTH: A/PHelps, A. E., III; B/Strineck, R. E.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL: NTIS SAP: HC 10S/1NF A01

MAJS: /AERODYNAMIC CHARACTERISTICS/AUXILIARY PROPULSION/HELICOPTERS/WIND TUNNEL STABILITY TESTS

MINS: /JET PROPULSION/ RIGID ROTORS/ THRUST AUGMENTATION/ WIND TUNNEL MODELS

ABA: G.G.

ABS: A wind-tunnel model test at advance ratios from 0 to 0.3 with and without auxiliary jet engine thrust is reported. At each advance ratio and engine thrust, both the control power and the aircraft stability were measured. The results indicate that there is a cross-coupling for collective pitch and longitudinal cyclic pitch inputs. The control power for these inputs increased with advance ratio. There was also cross-coupling for differential collective pitch inputs. The airframe was longitudinally unstable, but the instability was less at the highest advance ratio tested. The airframe showed both positive effective dihedral and positive directional stability.


US-PATENT-CLASS-416-144 78/04/04 8 PAGES UNCLASSIFIED DOCUMENT

Filed 19 Apr. 1977 Superseded N77-22452 (15 - 13, p 1725)

UTL: Non-destructive method for applying and removing instrumentation on helicopter rotor blades TSP: Patent

AUTH: A/LOGC, W. C.; B/WILLIAMS, W. L. PAT: B/inventors (to NASA)


MAJS: /HELICOPTERS/ NONDESTRUCTIVE TESTS/ ROTOR BLADES

MINS: /AIRFOILS/ PATENTS/ PRESSURE DISTRIBUTION/ ROTARY WING AIRCRAFT

ABA: Official Gazette of the U.S. Patent Office

ABS: A nondestructive method of applying and removing instrumentation on airfoils.

78N20128** ISSUE 11 PAGE 1396 CATEGORY 6 RPT#: NASA-TP-1146 L-11956 78/04/00 49 PAGES UNCLASSIFIED DOCUMENT

UTL: A rotor mounted digital instrument system for helicopter blade flight research measurements

AUTH: A/Knight, D. H., Jr.; B/Haywood, W. S., Jr.; C/Williams, M. L.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL: NTIS SAP: HC 10S/1NF A01

MAJS: /DIGITAL SYSTEMS/FLIGHT INSTRUMENTS/FLIGHT TESTS/ PRESSURE SENSORS/ ROTARY WINGS

MINS: /AIRFOILS/ DATA TRANSMISSION/ FREQUENCY DIVISION MULTIPLEXING/ HELICOPTERS/ PULSE CODE MODULATION

ABA: Author

ABS: A rotor mounted flight instrumentation system developed for helicopter rotor blade research is described. The system utilizes high speed digital techniques to acquire research data from miniature pressure transducers on advanced rotor airfoils which are flight tested on an Ah-1G helicopter. The system employs microelectronic pulse code modulation (PCM) multiplexer digitizer stations located remotely on the blade and in a hub mounted control canister. As many as 264 sensors can be remotely digitized by a 2.5 mm thick electronics package mounted on the blade near the tip to reduce blade wiring. The electronics contained in the canister digitizes up to 16 sensors, formats these data with serial PCM data from the remote stations, and transmits the data from the canister which is above the plane of the rotor. Data are transmitted over an RF link to the ground for real time monitoring and to the helicopter fuselage for tape recording. The complete system is powered by batteries located in the canister and requires no slip rings on the rotor shaft.

78N19144** ISSUE 10 PAGE 1266 CATEGORY 5 78/01/00 24 PAGES UNCLASSIFIED DOCUMENT

UTL: The rotor systems research aircraft: A new step in the technology and rotor system verification cycle


CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL: NTIS SAP: HC A15/1NF A01

In AGARD Rotorcraft Design 24 p (SEE N78-19126)
MAJS: /FLIGHT TESTS/RESEARCH VEHICLES/ROTOR WING AIRCRAFT
MINS: /AIRFRAMES/CALIBRATING/DATA ACQUISITION/ESCAPE SYSTEMS/PYROTECHNICS
ABA: Author
ABS: Rotor Systems research aircraft vehicles. Transition research, considering institution and technology developments. The capabilities of the RSRA aircraft for potential research programs are discussed.

79A10138* ISSUE 5 PAGE 752 CATEGORY 5 RPT#: AHS 78-12 78/06/00 11 PAGE* UNCLASSIFIED DOCUMENT
UTIL: Rotor Systems Research Aircraft/RSRA/Emergency Escape System
CORP: National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

MAJS: /AIRCRAFT DESIGN/ESCAPE SYSTEMS/HELICOPTER DESIGN/ROTOR SYSTEMS RESEARCH AIRCRAFT
MINS: /AIRCRAFT CONFIGURATIONS/Delay lines/Ejection seats/MECHANICAL ENGINEERING/PERFORMANCE TESTS/ PYROTECHNICS/ROTOR WINGS
ABA: Author
ABS: The three-man Rotor Systems Research Aircraft (RSRA) Emergency Escape System, the first system known to be fully qualified and operational in a rotary wing aircraft. Offers two modes of operation: one providing for a return to a fixed-wing aircraft, and the other for the severance of the rotor blades for a return to base as a fixed-wing aircraft. This paper describes the escape system's design principles, integration into the aircraft, qualification, and performance.

79A11758* ISSUE 5 PAGE 755 CATEGORY 6 78/06/00 9 PAGES UNCLASSIFIED DOCUMENT
UTIL: A new approach to helicopter rotor blade research

MAJS: /DATA ACQUISITION/FLIGHT TESTS/HELICOPTER DESIGN/IN-FLIGHT MONITORING/ROTOR WINGS/ROTOR BLADES
MINS: /AIRFOIL PROFILES/DATA TRANSMISSION/DIGITAL TECHNIQUES/MULTIPLEXING/PRESSURE SENSORS/PROPELLER BLADES/PULSE CODE MODULATION/REAL TIME OPERATION
ABA: Author
ABS: A rotor-blade-mounted telemetry instrumentation system developed and used in flight tests by the NASA/Langley Research Center is described. The system uses high-speed digital techniques to acquire research data from miniature pressure transducers on advanced rotor airfoils which are flight tested using a AH-1G helicopter. The system employs microelectronic PCM multiplex-digitizer stations located remote on the blades and in a hub-mounted metal canister. The electronics contained in the canister digitizes up to 16 sensors, formats this data with serial PCM data from the remote stations, and transmits the data from the canister which is above the plane of the rotor.
78111053-0 ISSUE 2 PAGE 150 CATEGORY 5 RPT:
NASA-TM-1046 L-11749 CNT#: D3 PROJ. 112-62209 AN-76
77/11/00 76 PAGES UNCLASSIFIED DOCUMENT

UTILT: Wind-tunnel tests of wide-chord teetering rotors with
and without outboard flapping hinges

Res. and Develop. Command, St. Louis, Mo.

CORP: National Aeronautics and Space Administration. Langley
Research Center, Hampton, Va.

AVAL NTIS SAP: HC A05/6F A01

WASHINGTON

MAJST: /ROARY WINGS/ ROTOR AERODYNAMICS/ TEETERING/ WIND
TUNNEL TESTS

MINS: / AERODYNAMIC CHARACTERISTICS/ DYNAMIC RESPONSE/
FLAPPING HINGES/ HELICOPTERS

ABA: Author

ABS: Wind tunnel tests of aerostatically designed
helicopter rotor models were conducted to obtain rotor
aerodynamic performance and dynamic response data
pertaining to two-bladed teetering rotors with a wider
chord and lower hover tip speed than currently
employed on production helicopters. The effects of a
flapping hinge at 62 percent radius were also studied.
Finally, the effects of changing tip mass on operating
characteristics of the rotor with the outboard
flapping hinge were examined. The models were tested
at several shaft angles of attack for five advance
ratios, 0.15, 0.25, 0.35, 0.40, and 0.45. From each
combination of shaft angle and advance ratio, the
rotor lift was varied over a wide range to include
simulated maneuver conditions. At each test condition,
rotor aerodynamic performance and dynamic response
data were obtained. From these tests, it was found
that wide-chord rotors may be subject to large control
forces. An outboard flapping hinge may be used to
reduce these forces bending moments over a significant
part of the blade radius without significantly
affecting the chordwise bending moments.

77151093-0 ISSUE 24 PAGE 4230 CATEGORY 71
RPT#: AIAA PAPER 77-1341 77/10/00 8 PAGES
UNCLASSIFIED DOCUMENT

UTILT: Some measured and calculated effects of a tip vortex
modification device on impulsive noise -- for
helicopter rotors

AUTH: A/PEGG, R. J.: B/WHITE, R. P., JR., PAA: A/NASA,
Langley Research Center, Hampton, Va.; B/Systems

CORP: National Aeronautics and Space Administration. Langley
Research Center, Hampton, Va.; Systems Research

American Institute of Aeronautics and Astronautics.
Aeroacoustics Conference, 4th, Atlanta, Ga., Oct. 3-5.
1977. 8 p.
MAJS: /*AIRCRAFT NOISE/*NOISE GENERATORS/*NOISE MEASUREMENT
/*ROTARY WINGS/*WING TIP VORTICES
MINS: /*FLOW VISUALIZATION/ HELICOPTERS/ NOISE REDUCTION/
NOISE SPECTRA/ SYSTEM EFFECTIVENESS/ WIND TUNNEL TESTS
ABA: M.L.
ABS: The results of a recent wind tunnel test program to
evaluate the effectiveness of the Tip Air Mass
Injection (TAMI) system in modifying the blade tip
vortexes occurring during helicopter flight is described
with attention to the effect of this modification on
the impulsive noise. The measurement program is
explained, and the correlation between experimental
and predicted results is discussed. Topics considered
include the effect of descent rate on noise magnitude,
time histories, the effect of air mass injection on
noise, and the analysis results based on a 6(A) weighted
approach. Impulsive noise generated by the interaction
of a helicopter rotor blade and the concentrated tip
vortex during forward flight descent is a primary
contributor to acoustic annoyance as it draws early
attention to the presence of the helicopter.

77H70069* ISSUE 24 PAGE 4103 CATEGORY 5 RPT:
AIAA PAPER 77-1340 77/10/00 10 PAGES UNCLASSIFIED
DOCUMENT
UTTL: Some results of the testing of a full-scale Ogee tip
helicopter rotor: acoustics, loads, and performance
AUTH: W. C. SHIDLER, P. A.; C/CAMPBELL, R. L.
PAA: D/US Army. Air Mobility Research and
Development Laboratory. Hampton, Va.; C/NSAR
CORP: D/US Army. Air Mobility Research and Development Lab.,
Hampton, Va.; National Aeronautics and Space
American Institute of Aeronautics and Astronautics,
Aeronautics Conference. 4th, Atlanta, Ga., Oct. 3-5,
1977. 10 p.
MAJS: /*AEROACOUSTICS/*FULL SCALE TESTS/*HELICOPTER
PERFORMANCE/*OGEE SHAPE/*ROTOR AERODYNAMICS/*TIP SPEED
MINS: /*AERODYNAMIC LOADS/ ROTARY WINGS/ UH-1 HELICOPTER
ABA: (Author)
ABS: Full-scale tests were utilized to investigate the
effect of the Ogee tip on helicopter rotor acoustics,
performance, and loads. Two facilities were used for
this study: the Langley whirl tower and a UH-1
helicopter. The test matrix for the whirl tower included
varied conditions from 0 to 44,480 N
(10,000 lbs) at several tip Mach numbers for both
standard and Ogee rotors. The full-scale testing on
the UH-1 encompassed the major portion of the flight
envelope for the aircraft. Both near-field acoustic
measurements as well as far-field flyover data were
obtained for both the Ogee and standard rotors. Data
analysis of the whirl-tower test shows that the Ogee
tip does significantly diffuse the tip vortex while
providing some improvement in noise performance.
Flight testing of both rotors indicates that the
strong impulsive noise signature of the standard rotor
can be reduced with the Ogee rotor. Forward flight
performance was significantly improved with the Ogee
configuration for a large number of flight conditions.
Further, rotor control loads and vibrations were
reduced through use of this advanced tip rotor.

77N32063* ISSUE 23 PAGE 3024 CATEGORY 2 RPT:
NASA-TM-1-354B L-11515 CMT# DA PRG.
111-0102-AH-45 77/09/00 120 PAGES UNCLASSIFIED
DOCUMENT
UTTL: Effect of rotor wake on aerodynamic characteristics of a
1/6 scale model of the rotor systems research
aircraft — in the Langley V/STOL tunnel
AUTH: P. E. simon, R. E., PAA: D/US Army. Mobility R and D
Lab., Langley, Va.
CORP: National Aeronautics and Space Administration. Langley
Research Center. Hampton, Va.; AVAIL.NTIS SAP: NC
AOGW21 AOG
Washington
MAJS: /*AERODYNAMIC CHARACTERISTICS/*CLAMPED HELICOPTER
/*AERODYNAMICS/*RESEARCH AIRCRAFT/* ROTOR
AERODYNAMICS/*SCALE MODELS/ WIND TUNNEL TESTS
MINS: /*AERODYNAMIC COEFFICIENTS/ AIRCRAFT CONFIGURATIONS/
AIRCRAFT STABILITY/ ANGLE OF ATTACK/ ROTARY WINGS
ABA: Author
ABS: Tests were conducted in the Langley V/STOL tunnel to
determine the effect of the main-rotor wake on
the aerodynamic characteristics of the rotor systems
research aircraft. A 1/6-scale model with a 4-blade
articulated rotor was used to determine the effect of

TERMINAL 20 PAGE 24 (ITEMS 70- 80 OF 158)
the rotor wake for the compound configuration. Data were obtained over a range of angles of attack, angles of sideslip, auxiliary engine thrusts, rotor collective pitch angles, and rotor tip-path plane angles for several main-rotor advance ratios. Separate results are presented for the forces and moments on the airframe, the wing, and the tail. An analysis of the test data indicates significant changes in the aerodynamic characteristics. The rotor wake increases the longitudinal static stability, the effective viscous damping, and the lateral static stability of the airframe. The rotor induces a downwash on the wing. This downwash decreases the wing lift and increases the drag. The asymmetrical rotor wake induces a differential lift across the wing and a subsequent rolling moment. These rotor induced effects on the wing become smaller with increasing forward speed.

The results of an evaluation of the effectiveness of current noise reduction technology in obtaining acceptable levels of interior noise in a large (about 20,000 kg) passenger-carrying helicopter are presented. The helicopter studied is a modified CH-53A with a specially designed, acoustically treated passenger cabin. The acoustic treatment reduced the average A-weighted interior noise levels from 125 db to 67 db. The study suggests selected improvements in the acoustic treatment which could result in additional reduction in cabin noise levels. The resulting levels would be only slightly greater than the interior noise levels of current narrow-body jet transports.
a new soft-inplane helicopter rotor. The unique feature of this rotor was the use of an internal elastomeric damper to restrain the blade inplane motion about the lead-lag hinge. The properties of the elastomer were selected to provide both a nominal first inplane frequency ratio of 0.65 and sufficient damping to eliminate the need for additional external damping sources to prevent ground resonance on a typical fuselage structure. For this investigation a 1/5-scale aerelastic model was used to represent the rotor. The four-blade model had a diameter of 3.05 m (10 ft) and a solidity of 0.103. The first out-of-plane frequency ratio was 1.06. The model was tested in hover and in forward flight up to an advance ratio of 0.45. At each forward speed the rotor lift was varied up to simulated maneuver conditions. The measured rotor loads and response were within acceptable limits, and no adverse response qualities were observed. Moderate out-of-plane hub moments were measured, even for zero lift, to indicate the beneficial control power available for this design. Blade inplane stability testing indicated that the rotor system damping remained at moderate levels throughout the operating envelope.

77N2059+/- ISSUE 15 PAGE 1936 CATEGORY 2 RPT: NASA-TR-X-71951 77/05/03 90 PAGES UNCLASSIFIED DOCUMENT

UTL: Theoretical study of the effect of ground proximity on the induced efficiency of helicopter rotors

AUTH: A/KEESEY, H. H.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAIL NTIS: SAP: HC AOS/ME ADQ

MADS: /GROUND EFFECT/AERO DYNAMICS/HELI COPTER PERFORMANCE

/ROT AY WIPES/HELI COPTER AERO DYNAMICS

MINS: /AERO DYNAMIC DRAG/HELICOPTER TAIL ROTORS/HOVERING STABILITY/UPWASH

ABA: Author

ABS: A study of rotors in forward flight within ground effect showed that the ground-induced interference is an upwash and a decrease in forward velocity. The interference velocities are large, oppose the normal flow through the rotor, and have large effects on the induced efficiency. Hovering with small ground clearances may result in significant blade stall. As speed is increased from hover to ground effect, power initially increases rather than decreases. At very low heights above the ground, the power requirements become nonlinear with speed as a result of the streamwise interference. The streamwise interference becomes greater as the wake approaches the ground and eventually distorts the wake to form the ground vortex which contributes to certain observed directional stability problems.

77N2059+/- ISSUE 17 PAGE 2211 CATEGORY 2 RPT: NASA-TR-X-71955 77/05/00 141 PAGES UNCLASSIFIED DOCUMENT

UTL: Airframe, wing, and tail aerodynamic characteristics of a 1/5-scale model of the rotor system research aircraft with the rotors removed

AUTH: A/KEESEY, H. H.; B/FREEMAN, C. E. PAA: /Army Air Mobility Res. and Develop. Lab., Hampton, Va./B/Army Air Mobility Res. and Develop. Lab., Hampton, Va.)
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

77N2309B ISSUE 14 PAGE 1008 CATEGORY 5 RPT:
NASA TM D-84247 L-11275 77/05/00 33 PAGES
UNCLASSIFIED DOCUMENT

AUTH: A/PAZISH, R. V.; B/HOBECK, J. A.; C/MARTIN, D. J., Jr.

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

MAJS: /FLIGHT SIMULATION+/HELICOPTER PERFORMANCE/+S-61 HELICOPTER+/VISUAL CONTROL

MINS: /CONTROL SIMULATION/FLIGHT SIMULATORS/LOW ALTITUDE/TASK COMPLEXITY

ABA: Author

ABS: Combined visual, motion, and aural cues for a helicopter engaged in visually conducted slalom runs at low altitude were studied. The evaluation of the visual and aural cues was subjective, whereas the motion cues were evaluated both subjectively and objectively. Subjective and objective results coincided in the area of control activity. Generally, less control activity is present under motion conditions than under fixed-base conditions, a fact attributed subjectively to the feeling of realistic limitations of a machine (helicopter) given by the addition of motion cues. The objective data also revealed that the slalom runs were conducted at significantly higher altitudes under motion conditions than under fixed-base conditions.

77N23573 ISSUE 14 PAGE 1871 CATEGORY 43 RPT:
NASA TM X-74032 77/04/00 190 PAGES
UNCLASSIFIED DOCUMENT

AUTH: A/HALL, J. B., Jr.; B/PEARSON, A. O.

ABA: Author

ABS: Results from the National Aeronautics and Space Administration remote sensing experiments in the New York Bight, 7-17 April 1975.
A cooperative operation was conducted in the New York Harbor to evaluate the role of remote sensing technology to monitor ocean dumping. Six NASA remote sensing experiments were flown on the C-54 U-2, and C-130 NASA aircraft, while NOAA obtained concurrent sea truth information using helicopters and surface platforms. The experiments included: (1) a Radiometer/Scatterometer (RADSAT), (2) an Ocean Color Scanner (OCS), (3) a Multichannel Ocean Color Sensor (MOC), (4) four Hasselblad cameras, (5) an Ebert spectrometer, and (6) a Reconfax IV infrared scanner and a Precision Radiation Thermometer (PRT-5). The results of these experiments relative to the use of remote sensors to detect, quantify, and determine the dispersion of pollutants dumped into the New York Harbor are presented.

77N22698* ISSUE 13 PAGE 1678 CATEGORY 5 RPT#: NASA-TR-X-3491 L-11200 77/04/00 43 PAGES UNCLASSIFIED DOCUMENT

Util: Computer simulation incorporating a helicopter model for evaluation of aircraft avionics systems

AUTH: A. OXSTOFF, A. J.; B. BROOK, R. B.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAIL NTIS SAP: HC A09/BF A01
Washington

MALS: *AVIONICS/COMPUTERIZED SIMULATION/HOPIECHELicopter CONTROL/MATHEMATICAL MODELS

MINS: / AIRCRAFT GUIDANCE/ CH-47 HELICOPTER/ COMPUTER PROGRAMS/ HELICOPTER DESIGN/ NAVIGATION AIDS

ABA: Author

ABS: A computer program was developed to integrate avionics research in navigation, guidance, controls, and displays with a realistic aircraft model. A user oriented program is described that allows a flexible combination of user supplied models to perform research in any avionics area. A preprocessors technique for selecting various models without significantly changing the memory storage is included. Also included are mathematical models for several avionics error models and for the CH-47 helicopter used in this program.

77N19008* ISSUE 10 PAGE 1255 CATEGORY 2 RPT#: NASA-TR-X-3476 L-11273 CNT#: D2 PROJ. 1115-64201 EM-76 77/03/00 54 PAGES UNCLASSIFIED DOCUMENT

Util: Wind tunnel investigation of an unpowered helicopter fuselage model with a V-type empennage

AUTH: A. FREEDMAN, C. E.; B. YEAGER, M. T., JR.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. Army Air Mobility Research and Development Lab., Hampton, Va. AVAIL NTIS SAP: HC A04/UF ADI
Washington Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

MALS: /FUSELAGES/HOPIECHELicopter/STATIC STABILITY/TAIL SURFACES

MINS: / BODY-WING AND TAIL CONFIGURATIONS/ STRUCTURAL DESIGN CRITERIA/ WIND TUNNEL MODELS/ ANGLE OF ATTACK/ CONTROL SURFACES/ DIMENSIONS/ LATERAL STABILITY/ LONGITUDINAL STABILITY/ PLANEFORM-STATIC STABILITY

ABA: Author

ABS: The applicability of a V-type empennage on an unpowered helicopter fuselage is considered as design criteria for improved navigation control devices. Configuration changes included variations of V-tail dihedral angle, planform area, and incidence angle. The configurations tested a V-tail with a dihedral angle of 55 deg, a total planform area of 0.4 sq. ft., and an incidence angle of 5 deg must nearly match the trim and static stability of the baseline conventional empennage.

SUM: Design optimization of empennage configuration for helicopter stability and control at high speed; the variables include dimensions, angle of attack, longitudinal characteristics, planform, fuselage, and lateral directional characteristics: 10 figures and no tables.

77N18417* ISSUE 9 PAGE 1127 CATEGORY 3 RPT#: NASA-TR-X-74007 77/03/00 21 PAGES UNCLASSIFIED DOCUMENT

Util: Helicopter sling load accident/incident survey: 1968

AUTH: A. SHAUGHNESSY, J. D.; B. PARDEE, M. D. PAA: B/Old Dominion Univ.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAIL NTIS SAP: HC A02/BF ADI

MALS: / AIRCRAFT ACCIDENT INVESTIGATION/HOPIECHELicopter PERFORMANCE/ HUMAN FACTORS ENGINEERING/ PILOT ERROR

ABA: Author

ABS: During the period considered a mean of eleven
accidents per year occurred and a mean of eleven persons were killed or seriously injured per year. Forty-one percent of the accidents occurred during hovering and 63 percent of the accidents had pilot error listed as a cause/factor. Many accidents involved pilots losing control of the helicopter or allowing a collision with obstructions to occur. There was a mean of 38 incidents each year and 51 percent of these occurred during cruise.

77N17102** ISSUE 8 PAGE 997 CATEGORY 8 RPT# NASA-TN-C-8095 L-10982 77/02/00 43 PAGES UNCLASSIFIED DOCUMENT

UTIL: The effect of variations in controls and displays on helicopter instrument approach capability


CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL NTIS SAP: HC 403/20 A01

Washington

MAJS: /APPROACH INDICATORS/FLIGHT Ctrl/R/HELICOPTER CONTROL/INSTRUMENT APPROACH

MINS: /ATTITUDE STABILITY/DECELERATION/ DISPLAY DEVICES/ HELICOPTER PERFORMANCE

ABA: Author

ABS: A flight investigation was conducted with a variable stability helicopter to determine the effects of variations in controls and displays on helicopter instrument approach capabilities. The baseline instrument approach task was a deceleration approach to a hover along a 6 deg glide slope. Pilot evaluations were obtained for both the constant speed part of the task and the deceleration and hover part of the task. The attitude stability augmentation system (SAS) was strongly preferred over the rate SAS because the aircraft had a divergent pitch response. From a display variation standpoint, it was not possible to decelerate to a hover in a consistent manner, regardless of the control system employed, with situation information only. In particular, the deceleration and hover part of the task was unacceptable without flight director command.

77N14999** ISSUE 6 PAGE 699 CATEGORY 2 RPT# NASA-TR-X-73950 77/01/00 175 PAGES UNCLASSIFIED DOCUMENT

UTIL: Two-dimensional aerodynamic characteristics of several rotorcraft airfoils at Mach numbers from 0.35 to 0.90


CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL NTIS SAP: HC 404/10 A01

MAJS: /AEROFOIL CHARACTERISTICS/AIRFOILS/*MACH NUMBER/* ROTORCRAFT AIRCRAFT/* TWO DIMENSIONAL FLOW

MINS: /AEROFOIL COEFFICIENTS/LIFT, THICKNESS RATIO, TRANSONIC WIND TUNNELS/WIND TUNNEL TESTS/*AIRFOIL PROFILES/*CATRIFICES/*POSIGN (LOCATION)

ABA: Author

ABS: An investigation was conducted in the Langley 6-by-29-inch transonic tunnel and the 6-by-19-inch transonic tunnel to determine the two-dimensional aerodynamic characteristics of several rotorcraft airfoils at Mach numbers from 0.35 to 0.90. The airfoils differed in thickness, thickness distribution, and camber. The FK69-H-008, the BHC-540, and the NASA 2302 airfoils were investigated in the 6-by-28-inch tunnel at Reynolds numbers (based on chord) from about 4.7 to 9.3 million at the lowest and highest test Mach numbers respectively. The FK69-H-008, the BHC-540, and the NASA 2302 airfoils were investigated in the 6-by-19-inch tunnel at Reynolds numbers from about 0.9 to 2.2 million at the lowest and highest test Mach numbers respectively.

SUM: Design coordinates and static pressure orifice locations for 5 airfoil models given in percent

S.: D/YENI, K. L.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL NTIS SAP: HC 402/20 A01

MAJS: /AIRCRAFT CONTROL/*BANDPASS FILTERS/*BANDWIDTH/* VIBRATION EFFECTS

MINS: /AEROFOIL STABILITY/ FILTERING/ HELICOPTER CONTROL/ HIGH GAIN/NOISE INTENSITY/ ROLL

ABA: Author

ABS: A modified complementary filtering technique for estimating aircraft roll rate was developed and flown in a research helicopter to determine whether higher gains could be achieved. Use of this technique did, in fact, permit a substantial increase in system frequency bandwidth because, in comparison with first-order filtering, it reduces both noise amplification and control limit-cycle tendencies.
airfoil chord; variables include upper surface, lower surface, stations; 10 tables include numeric data.

78A35662* ISSUE 14 PAGE 2666 CATEGORY 71 77/00/00 16 PAGES UNCLASSIFIED DOCUMENT
UUTL: Observed variability of aircraft noise footprint measurements
AUTH: B/MAGLIERI, D. J.; B/HENDERSON, H. R.; C/HILTON, D. A.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.


MAJS: /AIRCRAFT LANDING-FOOTPRINTS-GROUND EFFECT (AERODYNAMICS)/HELICOPTERS-JET AIRCRAFT NOISE/NOISE MEASUREMENT/TURBOJET ENGINES

MINS: /ATMOSPHERIC EFFECTS/DATA RECORDING/FIGHTER AIRCRAFT/NASA PROGRAM/NOISE POLLUTION/RADAR TRACKING/REMOTE CONTROL/TELEOPERATORS

ABA: G.R.

ABS: A description is presented of some measurements which illustrate the variability of the experimentally developed ground noise footprints for a series of landing approach operations of a turbojet aircraft and a turbine powered helicopter. Measurements on the right wing of the turbojet were conducted on the NASA Remotely Operated Multiple Array Acoustic Range. The information presented is related to a turbojet fighter aircraft and a turbine powered helicopter performing landing approach operations along a 3 deg approach path. Each vehicle was equipped with a transponder, and data was obtained using a receiver mounted on a distant aircraft. The measured variation in meteorological quantities for the two time periods during which these tests were conducted are presented in graphs. Other graphs show the ground noise contour for the turbojet aircraft and the turbine helicopter.

77A40569* ISSUE 1B PAGE 3002 CATEGORY 5 RPT:
AMS 77-33-15 77/00/00 10 PAGES UNCLASSIFIED DOCUMENT
UUTL: Efficient civil helicopters - The payoff of directed research
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.


MAJS: /NOISE REDUCTION/HELICOPTER DESIGN-PASSENGER AIRCRAFT-RESEARCH AND DEVELOPMENT
MINS: /AIRCRAFT MAINTENANCE/CIVIL AVIATION/ENERGY CONSUMPTION/HELICOPTER PERFORMANCE

ABA: Author

ABS: The effects of the characteristics of helicopter blade slap upon human annoyance are examined. Blade slap noise was simulated by using continuous and impulsive noises characterized by five parameters: the number of sine waves in a single impulse, the frequency of the sine waves, the impulse repetition frequency, the sound pressure level (SPL) of the continuous noise, and the idealized crest factor of the impulses. Ten second samples of noise were
synthesized with each of the five parameters at representative levels. The annoyance of each noise was judged by 40 human subjects. Analysis of the subjective data indicated that each of the five parameters had a statistically significant effect upon the annoyance judgments. The impulse crest factor and SPL of the continuous noise had very strong positive relationships with annoyance. The other parameters had smaller, but still significant, effects upon the annoyance judgments.

SUM: Psychoacoustic annoyance rating for impulsive noise characteristics; variables include number of sine waves, frequency of sine waves, impulse frequency, sound pressure level, and impulse peak ratios. 48 figures and 7 tables are included.

77N16276# ISSUE 7 PAGE 693 CATEGORY 30 RPT: NASA-I-M-X-73997 76/12/00 37 PAGES UNCLASSIFIED DOCUMENT

UTIL: Nonlinear curvature expressions for combined flapwise bending, chordwise bending, torsion and extension of twisted rotor blades


CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. NAVAL NTIS SAP: NC A05/MF A01

MAJS: /CURVATURE/ NONLINEAR EQUATIONS/ ROTOR BLADES

MINS: / AERELASTICITY/ ELASTIC BENDING/ EXTENSIONS/ HELICOPTERS

ABA: Author

ABS: The nonlinear curvature expressions for a twisted rotor blade or a beam undergoing transverse bending in cross sections, torsion, and extension were developed. The curvature expressions were obtained using simple geometric considerations. The expressions were first developed in a general manner using the geometrical nonlinear theory of elasticity. These general nonlinear expressions were then systematically reduced to four levels of approximation by imposing various simplifying assumptions, and in each of these levels the second degree nonlinear expressions were given. The assumptions were carefully stated and their implications with respect to the nonlinear theory of elasticity as applied to beams were pointed out. The transformation matrices between the deformed and undeformed blade-fixed coordinates, which were needed in the development of the curvature expressions, were also given for the three of the levels of approximation. The present curvature expressions and transformation matrices were compared with corresponding expressions existing in the literature.

77N16276# ISSUE 7 PAGE 873 CATEGORY 5 RPT: NASA-I-N-D-8378 L-11063 76/12/00 52 PAGES UNCLASSIFIED DOCUMENT

UTIL: Effects of rotor blade degradation on the accuracy of rotorcraft real time simulation

AUTH: A/HOGK, J. A.: B/BOWLES, R. L.

CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAIL NTIS SAP: NC A05/MF A01

MAJS: /CORPORALIZED SIMULATION/ ROTARY WINGS/ ROTORCRAFT AIRCRAFT

MINS: / DYNAMIC RESPONSE/ HELICOPTERS/ MATHEMATICAL MODELS/ REAL TIME SIMULATION

ABA: Author

ABS: The effects are studied of degrading a rotating blade element rotor mathematical model to meet various real-time simulation requirements of rotorcraft. Three methods of degradation were studied: reduction of number of blades, reduction of number of blade segments, and increasing the integration interval, which has the corresponding effect of increasing blade azimuthal advance angle. The three degradation methods were applied through static trim comparisons, total rotor force and moment comparisons, single blade force and moment comparisons over one complete revolution, and total vehicle dynamic response comparisons. Recommendations are made concerning model degradation which should serve as a guide for future users of this mathematical model. In general, they are in order of minimum impact on model validity: (1) reduction of number of blade segments, (2) reduction of number of blades, and (3) increase of integration interval and azimuthal advance angle. Extreme limits are specified beyond which the rotating blade element rotor mathematical model should not be used.
MATHEMATICAL MODELS/PITCH (INCLINATION)

ABA: Author
ABS: A flight investigation was conducted to determine the characteristic shapes of the altitude, ground speed, and acceleration profiles of visual approaches for helicopters. Two hundred thirty-six visual approaches were flown from nine sets of initial conditions with four types of helicopters. Mathematical relationships were developed that describe the characteristic visual deceleration profiles. These mathematical relationships were expanded to develop equations which define the corresponding nominal ground speed, pitch attitude, pitch rate, and pitch acceleration qualities in terminal area operations.

76A45183# ISSUE 23 PAGE 3541 CATEGORY 3 RPT#: AIAA PAPER 76-836 76/09/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTL: Civil helicopter flight research --- for CH-53 helicopter
AUTH: A/Snyder, W. J.; E/Scoultz, W. B. PAA: A/(NASA, Langley Research Center, Hampton, Va.)
MAJS: /H-53 HELICOPTER/HELICOPTER DESIGN/PAASSENGER AIRCRAFT/RESEARCH AIRCRAFT
MINS: /AIRCRAFT NOISE/CIVIL AVIATION/NASA PROGRAMS/OPERATIONAL PROBLEMS/RESEARCH AND DEVELOPMENT/RIDING QUALITY/STRUCTURAL VIBRATION

ABA: S. N.
ABS: The paper presents a description of the NASA CH-53 Civil Helicopter Research Aircraft and discusses preliminary results of the aircraft flight research performed for future helicopter transport operations. The CH-53 equipped with a 16-seat airline-type cabin and instrumentation for flight research studies in noise, vibration, flight dynamics, passenger acceptance and gust response. Predicted fuel usage for typical short haul missions is compared with actual fuel usage. Pilot ratings for an IFR handling quality task for three levels of stability augmentation are presented, and the effects of internal noise, vibration, and motion on passenger acceptance are discussed. Future planned CH-53 flight research within the Civil Helicopter Technology Program is discussed.

76A38079# ISSUE 19 PAGE 2974 CATEGORY 71 RPT#: AIAA PAPER 76-563 CH#: NGR-09-010-085 76/07/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Development of a noncompact source theory with applications to helicopter rotors
MAJS: /AERODYNAMIC NOISE/AIRCRAFT NOISE/ROTARY WINGS/SOUND PRESSURE
MINS: /HELICOPTERS/NOISE GENERATORS/ROTOR AERODYNAMICS

ABA: C. R. D.
ABS: A new formulation for determining the acoustic field of moving bodies, based on the linear analogy, is developed. The acoustic pressure is given as the sum of two integrals, one of which has a derivative with respect to time. The integrands are the functions of the
normal velocity and surface pressure of the body. A
computer program based on this formulation was used to
calculate acoustic pressure signatures for several
helicopter rotors from experimental surface pressure
data. Results are compared with those from compact
source calculations. It is shown that noncompactness
of steady sources on the rotor can account for the
high harmonics of the pressure system. Thickness noise
is shown to be a significant source of sound,
especially for blunt airfoils in regions where
noncompact source theory should be applied.

76A38070+ ISSUE 18 PAGE 2873 CATEGORY 71
RPT#: AIAA PAPER 76-551 76/07/00 7 PAGES
UNCLASSIFIED DOCUMENT
UTTL: Measurement, analysis, and prediction of aircraft
interior noise
AUTH: A/HOLLAND, J. T.; B/WILLIAMS, L. H.; C/CATHERINES,
J. J.; D/JVA, S. K. PAA: C/(NASA, Langley Research
Center, Hampton, Va.), D/(Cranfield Institute of
Technology, Cranfield, Beds., England)
CORP: Cranfield Inst. of Tech., Bedfordshire (England),; National Aeronautics and Space Administration, Langley
Research Center, Hampton, Va., American Institute of Aeronautics and Astronautics, 43rd Aeronautics Conference, 3rd Polc Alto, Calif.,
MAJS: /AIRCRAFT NOISE/NOISE MEASUREMENT/NOISE REDUCTION/*
PASSENGER AIRCRAFT/PREDICTION ANALYSIS TECHNIQUES
MINS: /COMFORT/FUSELAGES/GROUND TESTS/Helicoplers/LIGHT
AIRCRAFT/STRUCTURAL VIBRATION
ABA: (Author)
ABS: Considerations of comfort of passengers and crew in
light aircraft and helicopters indicate substantial
benefits may be obtained by the reduction of interior
noise levels. This paper discusses an ongoing research
effort to reduce interior noise in such vehicles. Data
from both field and laboratory studies for a light
aircraft are presented. The laboratory data indicate
that structural vibration is an efficient source of
interior noise and should be considered in the
reduction of interior noise. Flight data taken on a
helicopter before and after installation of acoustic
treatment demonstrate that over 30 dB of noise
reduction can be obtained in certain portions of the
spectra. However, subjective evaluations of the
treated vehicle indicate that further reductions in
interior noise are desirable. An existing interior
noise prediction method which was developed for large
jet transports was applied to study low-frequency
noise in a light aircraft fuselage. The results
indicate that improvements in the analytical model may
be necessary for the prediction of interior noise of
light aircraft.

76N28324+ ISSUE 19 PAGE 2320 CATEGORY 5 RPT:
NASA-JR-7-53922 76/07/00 42 PAGES UNCLASSIFIED
DOCUMENT
UTTL: Study of operational parameters affecting helicopter
fuel consumption -- using computer techniques
(computer programs)
AUTH: A/CROSS, J. ...; B/STEVENS, D. D.
CORP: National Aeronautics and Space Administration, Langley
Research Center, Hampton, Va. AVAIL.NTIS: SAP: HC
$4.00
MAJS: /COMPUTER PROGRAMS/COMPUTER TECHNIQUES/FUEL
CONSUMPTION/HELICOPTERS
MINS: AIRCRAFT FUELS/NASA PROGRAMS/RESEARCH AIRCRAFT/
TABLES (DATA)/TECHNOLOGY UTILIZATION
ABA: Author
ABS: A computerized study of operational parameters
affecting helicopter fuel consumption was conducted as
an integral part of the NASA Civil Helicopter
Technology Program. The study utilized the Helicopter
Sizing and Performance Computer Program (HESCOM)
developed by the Boeing-Vertol Company and NASA Ames
Research Center. An introduction to HESCOM is
incorporated in this report. The results presented
were calculated using the NASA Ch-53 civil helicopter
research aircraft specifications. Plots from which
optimum flight conditions for minimum fuel use that
can be flown in the aircraft are presented for this aircraft. The
results of the study are considered to be generally
indicative of trends for all helicopters.

76A33795+ ISSUE 16 PAGE 2426 CATEGORY 5
76/05/00 7 PAGES UNCLASSIFIED DOCUMENT
UTTL: A review of some tilt-rotor aerelastic research at
NASA-Langley
Center, Aerelasticity Branch, Hampton, Va.)
CORP: National Aeronautics and Space Administration, Langley
Research Center, Hampton, Va.
MAJS: /AEROLESTICITY/RESEARCH PROJECTS/DEPORT/VERTICAL
RESEARCH AIRCRAFT PROGRAM/VERTICAL TAKEOFF AIRCRAFT
MINS: /BELL AIRCRAFT/FLIGHT ANALYSIS/JUST LOADS/NASA
PROGRAMS/WIND TUNNEL MODELS
ABA: (Author)
ABS: An overview of an experimental and analytical research
program conducted within the Aerelasticity Branch of
the NASA Langley Research Center for studying the
aerelastic and dynamic characteristics of tilt-rotor
VTOL aircraft is presented. Selected results from
several joint NASA/contractor investigations of scaled
models in the Langley transonic dynamics tunnel are shown and discussed with a view toward delineating various aspects of dynamic behavior peculiar to propeller aircraft. Included are such items as propeller/pylon stability, whirl flutter, gust response, and blade flapping. Theoretical predictions, based on analyses developed at Langley, are shown to be in agreement with the measured stability and response behavior.


The Rotor Systems Research Aircraft (RSRA), a compound rotor/fixed-wing aircraft, incorporates an emergency escape system for the three crew members: to achieve unobstructed egress, the overhead acrylic canopies of each crew member will be explosively severed and fractured into predictable small, low-mass pieces. A canopy explosive severance/fracture system was developed under this investigation that included the following system design considerations: selection of canopy and explosive materials, determining the acrylic's explosive severance and fracture characteristics, evaluating the effects of installation variables and temperature, determining the most effective explosive patterns, conducting full-scale, flat and double-curvature canopy tests, and evaluating the effects of backblast of the explosive into the cockpit.


On previous helicopter instrument approach studies, pilot comments frequently indicated that the
deceleration profiles were characterized by 'unnatural cues', and it was found that the pilots were comparing the motion and attitude cues with those obtained during visual approaches. Prior to this study, the characteristic shape of visual approach profiles had not been formally documented. Over 200 visual approaches were flown using different helicopter types, test subjects, and initial conditions, and the attitude and groundspeed profiles were measured by a precision tracking radar. The data from each approach were then processed, and the characteristic shape of the altitude, groundspeed, and deceleration profiles was determined for each set of initial conditions. These flight data were processed further using graphical analysis techniques and parameterization, which, in turn, led to developing closed-form equations that accurately describe the characteristic groundspeed and deceleration profiles. Results from this study can be used to select instrument approach profiles, to develop instrument approach control laws, and to define the corresponding hardware requirements.

77A26870* ISSUE 11 PAGE 1761 CATEGORY 5
76/00/00 15 PAGES UNCLASSIFIED DOCUMENT


CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.


MAJS: /AERODYNAMIC STABILITY/FLAPPING/HELICOPTER PERFORMANCE/ROTARY WINGS

MINS: /LAPLACE TRANSFORMATION/MATHEMATICAL MODELS/PERTURBATION THEORY/STEADY STATE

ABA: (Author)

ABS: A critical examination of flap-lag stability of a centrally hinged, spring-restrained rigid blade in both hover and forward flight is presented. Several differences in the equations of motion for blade flap-lag stability in the existing literature are identified. A rigorous and systematic development of these equations for a rigid articulated blade in forward flight shows the existence of some linear aerodynamic coupling terms associated with blade steady-state flapping and lagging in the perturbation equations. The differences identified are shown to be associated with the order in which the flap and lag transformations are taken in developing the equations of motion. The implications of these differences on stability are examined, and it is shown that the pitch-lag coupling terms associated with a flap-lag hinge transformation sequence have a marked influence on flap-lag stability. Some qualitative considerations on the effect of the assumed transformation sequence in the development of the flap-lag equations for a hingeless elastic blade are also given. On the basis of these considerations, it is shown that aerodynamic coupling terms associated with blade steady-state flapping and lagging similar to those found for the rigid blade will also appear in the equations for the elastic blade.

77A26900* ISSUE 7 PAGE 1096 CATEGORY 63
76/00/00 8 PAGES UNCLASSIFIED DOCUMENT


CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.; Old Dominion University, Norfolk, Va.


MAJS: /DYNAMIC CONTROL/FEEDBACK CONTROL/LINEAR SYSTEMS/OPTIMAL CONTROL/STOCHASTIC PROCESSES/WHITE NOISE

MINS: /COMPENSATORS/CONSTRAINTS/CONTROL THEORY/HELICOPTER DESIGN/REGULATORS/SPACE STATIONS/SPACECRAFT DESIGN/TIME CONSTANT

ABA: (Author)

ABS: This paper considers the problem of designing certain structurally constrained optimal regulators for linear systems subjected to additive white process noise and measurement noise. Three types of controller structures are considered, using direct output feedback, prespecified time constant filters, and optimal dynamic compensators. Necessary conditions are obtained for minimizing quadratic performance criteria. The techniques are demonstrated by application to a helicopter/slung load system, and a flexible space station.
A general rotor model system for wind tunnel investigation of rotorcraft aerodynamics and acoustics

AUTH: A/WILSON, J. C. PAA: A/NASA, Langley Research Center; U.S. Army, Air Mobility Research and Development Laboratory, Hampton, Va.)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.


MALS: /AERODYNAMIC CONFIGURATIONS/ AIRCRAFT PERFORMANCE/ AIRCRAFT STABILITY/ CONTROL STABILITY/ RESEARCH AND DEVELOPMENT/ TAIL ROTORS/ VSTOL AIRCRAFT/ WIND TUNNEL MODEL.

ABA: (Author)

ABS: A complex rotorcraft model system has been developed by the NASA Langley Research Center and the U.S. Army Air Mobility R&D Laboratory, Langley Directors, for aerodynamic and acoustic experimental investigations in the NASA Langley VSTOL tunnel. This generalized rotor model system has a powered main rotor, tail rotor, and auxiliary engine capability. It may be configured to represent a variety of rotorcraft configurations. The first investigation was conducted to determine the performance, acoustic, stability and control characteristics of the NASA/Army Rotor System Aircraft with an articulated rotor. In a second investigation, a quarter-scale AH-1G configuration with a tautening rotor is being represented to determine if the V-tail will improve the directional characteristics. Future programs are planned to investigate advanced rotor blade airfoils for improved performance and acoustic characteristics.


MALS: /AIRCRAFT WAKES/DYNAMIC RESPONSE/FIXED WINGS/ FLIGHT TESTS/HELICOPTER PERFORMANCE/ VORTEX STREETS

MINS: C-54 AIRCRAFT/ DIGITAL SIMULATION/ HELICOPTER TAIL ROTOR/ VORTEX ROVING WINGS/ UH-1 HELICOPTER/ VORTEX GENERATORS/ WING TIP VORTICES

ABA: (Author)

ABS: A flight investigation was conducted to quantitatively determine the response of a medium-lift helicopter to the trailing vortex system of a fixed-wing aircraft. Flight tests and analytical tools were both utilized in the investigation. The flight tests involved an extensively instrumented UH-1H helicopter and a C-54 aircraft. Penetrations of the vortex system by the UH-1H were made at the following nominal conditions: the C-54 flew at 5500 feet altitude at a nominal gross weight of 58,000 pounds and an indicated airspeed of 115 knots in a cruise configuration. The UH-1H, normally 7200 pounds gross weight, flew at 60 knots indicated airspeed during the penetrations at separation distances of 6.64 nautical miles to 4.42 nautical mile between aircraft. In general, the data analyzed for the above tests indicated that no unsafe penetration occurred. Further, penetrations vehicle attitude changes and structural loads were nominal. In addition, the response of the helicopter did not change appreciably with decreased separation distance.


MALS: /AIRCRAFT WAKES/DYNAMIC RESPONSE/FIXED WINGS/ FLIGHT TESTS/HELICOPTER PERFORMANCE/ VORTEX STREETS

MINS: C-54 AIRCRAFT/ DIGITAL SIMULATION/ HELICOPTER TAIL ROTOR/ VORTEX ROVING WINGS/ UH-1 HELICOPTER/ VORTEX GENERATORS/ WING TIP VORTICES

ABA: (Author)

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78N76053 CATEGORIZE 5 RPT: NASA-78-X-72818-SUPPL 76/00/00 225 PAGES UNCLASSIFIED DOCUMENT

Aerodynamic characteristics of a powered tilt rotor wind tunnel model.

AUTH: A/WILSON, J. C.; B/MINECK, R. E.; C/FREIBERG, C. E.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ABA: (Author)

ABS: A complex rotorcraft model system has been developed by the NASA Langley Research Center and the U.S. Army Air Mobility R&D Laboratory, Langley Directors, for aerodynamic and acoustic experimental investigations in the NASA Langley VSTOL tunnel. This generalized rotor model system has a powered main rotor, tail rotor, and auxiliary engine capability. It may be configured to represent a variety of rotorcraft configurations. The first investigation was conducted to determine the performance, acoustic, stability and control characteristics of the NASA/Army Rotor System Aircraft with an articulated rotor. In a second investigation, a quarter-scale AH-1G configuration with a tautening rotor is being represented to determine if the V-tail will improve the directional characteristics. Future programs are planned to investigate advanced rotor blade airfoils for improved performance and acoustic characteristics.


MALS: /AIRCRAFT WAKES/DYNAMIC RESPONSE/FIXED WINGS/ FLIGHT TESTS/HELICOPTER PERFORMANCE/ VORTEX STREETS

MINS: C-54 AIRCRAFT/ DIGITAL SIMULATION/ HELICOPTER TAIL ROTOR/ VORTEX ROVING WINGS/ UH-1 HELICOPTER/ VORTEX GENERATORS/ WING TIP VORTICES

ABA: (Author)

ABS: A flight investigation was conducted to quantitatively determine the response of a medium-lift helicopter to the trailing vortex system of a fixed-wing aircraft. Flight tests and analytical tools were both utilized in the investigation. The flight tests involved an extensively instrumented UH-1H helicopter and a C-54 aircraft. Penetrations of the vortex system by the UH-1H were made at the following nominal conditions: the C-54 flew at 5500 feet altitude at a nominal gross weight of 58,000 pounds and an indicated airspeed of 115 knots in a cruise configuration. The UH-1H, normally 7200 pounds gross weight, flew at 60 knots indicated airspeed during the penetrations at separation distances of 6.64 nautical miles to 4.42 nautical mile between aircraft. In general, the data analyzed for the above tests indicated that no unsafe penetration occurred. Further, penetrations vehicle attitude changes and structural loads were nominal. In addition, the response of the helicopter did not change appreciably with decreased separation distance.


MALS: /AIRCRAFT WAKES/DYNAMIC RESPONSE/FIXED WINGS/ FLIGHT TESTS/HELICOPTER PERFORMANCE/ VORTEX STREETS

MINS: C-54 AIRCRAFT/ DIGITAL SIMULATION/ HELICOPTER TAIL ROTOR/ VORTEX ROVING WINGS/ UH-1 HELICOPTER/ VORTEX GENERATORS/ WING TIP VORTICES

ABA: (Author)

ABS: A flight investigation was conducted to quantitatively determine the response of a medium-lift helicopter to the trailing vortex system of a fixed-wing aircraft. Flight tests and analytical tools were both utilized in the investigation. The flight tests involved an extensively instrumented UH-1H helicopter and a C-54 aircraft. Penetrations of the vortex system by the UH-1H were made at the following nominal conditions: the C-54 flew at 5500 feet altitude at a nominal gross weight of 58,000 pounds and an indicated airspeed of 115 knots in a cruise configuration. The UH-1H, normally 7200 pounds gross weight, flew at 60 knots indicated airspeed during the penetrations at separation distances of 6.64 nautical miles to 4.42 nautical mile between aircraft. In general, the data analyzed for the above tests indicated that no unsafe penetration occurred. Further, penetrations vehicle attitude changes and structural loads were nominal. In addition, the response of the helicopter did not change appreciably with decreased separation distance.
A research aircraft for investigating the factors involved in civil helicopter operations was developed for NASA Langley Research Center. The aircraft is reconfigured 17000 kg (36000 lb) military transport helicopter. The basic aircraft was reconfigured with advanced acoustic treatment, air-conditioning, and a 16-seat airline cabin. During the spring of 1975, the aircraft was flown to measure interior environment characteristics - noise and vibration - and was flown on 60 subjective flight missions with over 600 different subjects. Data flights established noise levels somewhat higher than expected, with a pure tone at 1400 Hz and vertical vibration levels between 0.07g and 0.17g. The noise and vibration levels were documented during subjective flight evaluations as being the primary source of discomfort. The aircraft will be utilized to record in detail the impact of various noise and vibration levels on passenger comfort during typical short-haul missions.
A momentary analysis of helicopters and autogiros in inclined descent, with comments on operational restrictions.

The author, A. Heysen, discusses the development of a momentary theory for descending flight. Experimental data indicates that the theory, when properly interpreted, yields the optimum performance of the rotor. Power settling can be explained on the basis of the theory. The reasons for operational restrictions on descending flight are discussed. The maximum autorotative performance of a rotor is determined; the theory shows good agreement with flight measurements. Similar equations were developed for a wing. It was shown that the ideal performance of an autorotating rotor is independent of that of a wing of equal aspect ratio. A limiting maximum wing lift coefficient, which is confirmed by existing experimental data, was obtained.

The application of composites to aerospace vehicle structures is reviewed. Research and technology program results and specific applications to space vehicles, aircraft engines, and aircraft and helicopter structures are discussed in detail. Particular emphasis is given to flight service evaluation programs that are or will be accumulating substantial experience with secondary and primary structural components on military and commercial aircraft to increase confidence in their use.
MAJS: /AIRCRAFT NOISE/ COMPUTER PROGRAMS/ ROTARY WINGS
MINS: /ACOUSTIC MEASUREMENT/ HELICOPTERS/ TIME

ABA: Author

ABS: A computer program (D3910) was developed to calculate both the far field and near field acoustic pressure signature of a tilted rotor in hover or uniform forward speed. The analysis, carried out in the time domain, is based on Lowson's formulation of the acoustic field of a moving force. The digital computer program is described, including methods used in the calculations. A flow chart, program D3910 source listing, instructions for the user, and two test cases with input and output listings and output loading.

75N30030* ISSUE 21 PAGE 2603 CATEGORY B
75/06/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Potential benefits to short-haul transports through use of active controls
AUTH: A/CONNER, D. W.; B/THOMPSON, G. O. PAA: B/ (Boeing Co., Wichita, Kans.)
IG AGARD Impact of Active Control Technol. on Airplane Design 10 p (SEE N75-30027 21-01)
MAJS: /AIRCRAFT CONTROL/HELIICOPTERS/ SHORT HAUL AIRCRAFT
MINS: /AIRCRAFT DESIGN/ AIRCRAFT STABILITY/ FLIGHT CONTROL/ GUST LOADS/ TRANSPORT AIRCRAFT/ WING LOADING

ABA: Author

ABS: The potential applications of active controls are examined for improving the characteristics of transport type aircraft used in short-haul service (1,000 kilometer range capability). The type of aircraft to meet future needs (quiet operation, congestion alleviation, fuel conservation, operating economy, and traveler acceptance) are identified as helicopters for shorter stage lengths and fixed wing aircraft of reduced field-length capability for longer stage lengths. Likely uses for active controls for these aircraft are examined regarding payoffs which can be expected and problems and constraints which must be dealt with. Uses showing significant benefits include augmented stability and control, gust-load alleviation, and ride smoothing. Gust-load alleviation is particularly effective for low-wing loading aircraft employing conventional lift. Ride-smoothing systems are indicated to be the furthest advanced and ready for production commitment for those applications where they can be shown to have payoff.

75N30013* ISSUE 21 PAGE 2602 CATEGORY 5
75/05/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Importance of helicopter dynamics to the mathematical model of the helicopter
AUTH: A/WHITE, W. F., JR.
MAJS: /AIRCRAFT STABILITY/ HELICOPTER PERFORMANCE/ MATHMATICAL MODELS/ PARAMETERIZATION
MINS: /COMPUTER PROGRAMS/ NONLINEAR EQUATIONS/ NUMERICAL ANALYSIS/ RESONANT FREQUENCIES/ ROTARY WINGS

ABA: Author

ABS: A mathematical model of the helicopter requires appropriate representation of the constituent elements of rotor dynamics. General-purpose programs that model a variety of configurations for a broad range of operating conditions result in varying and incompatible levels of sophistication. Analysis of specific dynamic problems facilitates the identification of configuration parameters which determine system behavior. For the present analysis, the nonlinear equations of a torsionally rigid, hingeless rotor are linearized about an equilibrium condition to determine flap-lag stability.
characteristics in hover. A collocation method was
used to obtain the coupled natural frequencies and
mode shapes. These modes allow exact treatment of the effect
of elastic coupling which more than compensates for the
destabilizing inertial coupling. The sensitivity of damping to the number of modes was found to be
small, and reasonable accuracy was obtained in the first
flapwise and edgewise coupled modes. The range of
destabilizing precone was found to be small.

ABS: The effects of rotor wake on helicopter fuselage
aerodynamic characteristics were investigated in the
Langley V-510L tunnel. Force, moment, and pressure
data were obtained on three fuselage models at various
combinations of windspeed, sideslip angle, and pitch
angle. The data show that the influence of rotor wake
on the helicopter fuselage yawing moment imposes a
significant additional thrust requirement on the tail
rotor of a single-rotor helicopter at high sideslip
angles.

75N15607# ISSUE 7 PAGE 727 CATEGORY 1 RPT#: NASA-IN-D-7796 L-9710 75/02/00 24 PAGES
UNCLASSIFIED DOCUMENT

UTLT: An analytical evaluation of airfoil sections for
civil helicopter rotor applications
AUTH: A/BRIDHAM, G. J.
CORP: National Aeronautics and Space Administration, Langley
Research Center, Hampton, Va.; Army Air
Mobility Research and Development Lab., Hampton, Va.
AVAIL. NTIS SAP: HC $3.25
Washington Prepared in cooperation with Army Air
Mobility R and D Lab., Hampton, Va.
MAJS: / AERODYNAMIC DRAG/AIRFOIL PROFILES/HELICOPTER
DESIGN/ROTARY WINGS
MINS: / AERODYNAMIC CHARACTERISTICS/ NUMERICAL ANALYSIS/
PERFORMANCE PREDICTION
ABA: Author

ABS: An analytical technique was used to evaluate airfoils
for helicopter rotor application. This technique
permits assessment of the influences of airfoil
geometric variations on drag divergence Mach number at
lift coefficients from near zero to near maximum lift.
Analytical results presented in this paper indicate
the compromises in drag divergence Mach number which
result from changes in (1) thickness ratio, (2)
location of maximum thickness, (3) leading-edge
radius, (4) camber addition, and (5) location of
maximum camber of NASA four- and
double-series
airfoils and some 5-series airfoils of potential
interest for helicopters. Examples of airfoil sections
which combine several of the geometric changes
required by both advancing and retreating section
performance have been presented.
Research Center, Hampton, Va.


MAJS: /FEEDBACK CONTROL/LINEAR SYSTEMS/OPTIMAL CONTROL/STOCHASTIC PROCESSES/SYSTEMS ENGINEERING

MINS: /ALGORITHMS/HELICOPTER CONTROL/MATRICES (MATHEMATICS)/WHITE NOISE/WIND EFFECTS

ABA: (Author)

ABS: The problem of obtaining an optimal control law, which is constrained to be a feedback of the available measurements, is considered for both continuous and discrete-time linear systems subjected to additive white process noise and measurement noise. Necessary conditions are obtained for guaranteeing a quadratic performance function for both continuous and discrete-time cases. The feedback gain matrices are constrained to be constant for the continuous-time case. Necessary conditions are derived for generating a sequence of feedback gain matrices which successively improve the performance function. Computational aspects are discussed via application to two continuous-time processes, including a helicopter/land load system subjected to measurement noise and random wind gust input.

76A11831+ ISSUE 2 PAGE 221 CATEGORY 60 75/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTIL: HOME - An application of fault-tolerant techniques and system self-testing -- independent computer for helicopter flight control and command monitoring

AUTH: P. J. PAR; A/(NASA. Langley Research Center, Hampton, Va.)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.


MAJS: /AIRBORNE/SATellite SYSTEMS/OPTICAL SYSTEMS/FLIGHT CONTROL/OPTICAL MONITORING/RELIABILITY ENGINEERING

MINS: /AIRCRAFT RELIABILITY/CIRCUIT RELIABILITY/COMMAND AND CONTROL/ELECTRONIC EQUIPMENT TESTS/FLIGHT SAFETY/HELICOPTER DESIGN/THRESHOLD LOGIC

ABA: (Author)

ABS: Hard Over Monitoring Equipment (HOME) has been designed to complement and enhance the flight safety of a flight research helicopter. HOME is an independent, highly reliable, and fail-safe special purpose computer that monitors the flight control commands issued by the flight control computer of the helicopter. In particular, HOME detects the issuance of a hazardous hard-over command for any of the flight control axes and transfers the control of the helicopter to the flight safety pilot. The design of HOME incorporates certain reliability and fail-safe enhancement design features, such as triple modular redundancy, a majority logic voting scheme, and in-flight self-test. A built-in preflight exerciser tests the HOME design and operation is described with special emphasis on the reliability and fail-safe aspects of the design.

75N1294+ ISSUE 4 PAGE 381 CATEGORY 5 RPT: NASA-TM-X-3161 L-923 74/12/00 71 PAGES UNCLASSIFIED DOCUMENT

UTIL: Wind tunnel investigation of a simulated Gunship helicopter engine-exhaust wind tunnel interaction

AUTH: J. L. WILSON, J. C.; B/WINFECK, R. E.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.: Army Air Mobility Research and Development Lab., Hampton, Va.

AVAIL: NTIS $C: $4.25

Washington Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

MAJS: /EXHAUST GASES/HELICOPTER ENGINES/WIND TUNNEL TESTS

MINS: /COWLINGS/FLOW DEFLECTION/FLOW VISUALIZATION/FREE FLOW/IMPINGEMENT/WIND EFFECTS

ABA: Author

ABS: A wind tunnel investigation of the engine exhaust and wind tunnel flow interaction of a gunship helicopter model was conducted in the Langley V/STOL tunnel. The investigation utilized a flow visualization technique employing neutrally buoyant helium filled bubbles to determine the cause of exhaust shield overheat during cruising flight and to evaluate means of eliminating the problem. The flow patterns were recorded with still cameras and on television magnetic tape. Exhaust flow impingement on the exhaust shield during cruise was found to cause the problem. Several flow altering devices were evaluated to find suitable ways to correct the problem. A flow deflector located on the model cowl region upstream of the exhaust provides an effective solution.
additional cases representing procedures currently employed by military and commercial operators. Although an increase in pilot workload was noted when the television system was used, the results indicated a comparable level of performance for each test case.

75N11931*# ISSUE 3 PAGE 252 CATEGORY 5 RPT#:
NASA-TN-D-7694 L-9325 7/11/00 176 PAGES
UNCLASSIFIED DOCUMENT
UTTL: A wind tunnel investigation of parameters affecting helicopter directional control at low speeds in ground effect
AUTH: A/YEAGER, W. T., JR.; B/YOUNG, W. H., JR.; C/YANTAY, W. R.
CORP: National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. AVAL.LNTIS SAP: HC $7.00 Washington
MAJS: /DIRECTIONAL CONTROL/HEICOPTERS/TAIL ASSEMBLIES/WIND TUNNEL TESTS
MINS: /AERODYNAMIC CHARACTERISTICS/GROUND EFFECT/HELICOPTER MAKES/ROTOR AERODYNAMICS
ABA: Author
ABS: An investigation was conducted in the Langley full-scale tunnel to measure the performance of several helicopter tail-rotor configurations with regard to directional control problems encountered at low speeds in ground effect. Tests were conducted at wind azimuth angles of 0 deg to 360 deg in increments of 30 deg and 60 deg and at wind speeds from 0 to 35 knots. The results indicate that at certain combinations of wind speed and wind azimuth, large increases in adverse fin force require correspondingly large increases in the tail-rotor thrust, collective pitch, and power required to maintain fin trim. Changing the tail-rotor direction of rotation to top blade aft for either a pusher tail rotor (tail-rotor wake blowing away from fin) or a tractor tail rotor (tail-rotor wake blowing against fin) will alleviate this problem. For a pusher tail rotor at 180 deg wind azimuth, increases in the fin/tail-rotor gap were not found to have any significant influence on the overall vehicle directional control capability. Changing the tail rotor to a higher position was found to improve tail-rotor performance for a fin-off configuration at a wind azimuth of 180 deg. A V-tail configuration with a pusher tail rotor with top blade aft direction of rotation was found to be the best configuration with regard to overall directional control capability.
A method of automatically stabilizing helicopter sling loads

A HATRA, J.: B/FARMER, S. W. JR.

National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NITIS SAP: HC $3.25

Washington

AIRCRAFT EQUIPMENT/EXTERNAL STORES/HELICOPTERS/MATERIALS HANDLING

AERODYNAMIC CHARACTERISTICS/AERODYNAMIC STABILITY/HELIICOPTER CONTROL

The effect of geometric and aerodynamic characteristics on the stability of the lateral degrees of freedom of a typical helicopter sling load is examined. The feasibility of stabilizing the suspended load by controlling fins was also studied. Linear control theory was applied to the design of a simple control law that stabilized the load over a wide range of helicopter airspeeds.

A KYLL, J. R.; B/NIESSEN, F. R.; C/THIBODEAUX, J. J.; D/YENN, K. R.; E/CARR, J. F. JR.

National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NITIS SAP: HC $3.25

Washington

AIRCRAFT LANDING/HELICOPTERS/INSTRUMENT LANDING SYSTEMS/VERTICAL TAKEOFF AIRCRAFT

APPROACH CONTROL/AUTOMATIC LANDING CONTROL/DISPLAY DEVICES/FLIGHT SAFETY/GLIDE PATHS

A Flight investigation was undertaken to study the problems associated with manual and automatic control of steep, decelerating instrument approaches and landings under simulated instrument conditions. The study was conducted with a research helicopter equipped with a three-cue flight-director indicator. The scope of the investigation included variations in the flight-director control laws, glide-path angle, deceleration profile, and control response characteristics. Investigation of the automatic-control problem resulted in the first automated approach and landing to a predetermined spot ever accomplished with a helicopter. Although:

well-controlled approaches and landings could be performed manually with the flight-director concept, pilot comments indicated the need for a better display which would more effectively integrate command and situation information.

A PEGG, R. J.; B/HILTON, D. A.

National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NITIS SAP: HC $3.25

Washington

ACOUSTIC MEASUREMENT/BELL AIRCRAFT/ENGINE NOISE/EXHAUST GASES/HELICOPTERS/MUFFLERS/NOISE REDUCTION

ACOUSTIC PROPERTIES/AIRCRAFT EQUIPMENT/EQUIPMENT SPECIFICATIONS/MUFFLERS

A Field noise measurement program has been conducted on a standard Bell 206 series helicopter and on one that had been modified with specially designed, airframe-mounted mufflers to reduce the engine exhaust noise. The purpose of the study was to evaluate the
acoustic performance of five experimental exhaust muffler configurations for a helicopter reciprocating engine in an operational environment. All muffler configurations produced a beneficial engine exhaust noise reduction but some configurations were markedly better than others. Floyover noise results indicated that maximum overall noise reductions of approximately 8 dB were obtained with the various mufflers. The rotor noise was judged to be the dominant noise component for the muffler-equipped helicopters whereas the engine noise was the dominant component for the basic configuration.

74N70G59# ISSUE 12 PAGE 1372 CATEGORY 2 RPT#: NASA-TM-X-71957 74,04/24 16 PAGES UNCLASSIFIED DOCUMENT

UTL: The noise environment of a school classroom due to the operation of utility helicopters - acoustic measurements of helicopter noise during flight over building

AUTH: A/HILTON, D. A.; B/PEGG, R. J.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AVAIL: NTIS SAP: HC $4.00
Presented at 87th Meeting of the Acoust. Soc. of Am., New York City, 24 Apr. 1974

MAJS: /ACOUSTIC MEASUREMENT/AIRCRAFT NOISE/HELICOPTERS/NOISE INTENSITY/UTILITY AIRCRAFT

MINS: /ACOUSTIC PROPERTIES/HUMAN FACTORS ENGINEERING/NOISE PROPAGATION/NOISE SPECTRA

ABA: Author

ABS: Noise measurements under controlled conditions have been made inside and outside of a school building during flyover operations of four different helicopters. The helicopters were operated at a condition considered typical for a police patrol mission. Flyovers were made at an altitude of 500 ft and an airspeed of 45 miles per hour. During these operations acoustic measurements were made inside and outside of the school building with the windows closed and then open. The outside noise measurements during helicopter flyovers indicate that the outside dB(A) levels were approximately the same for all test helicopters. For the windows closed case significant reductions for the inside measured dB(A) values were noted for all flyovers. These reductions were not more that 20 dB(A); similar reductions were noted in other subjective measuring units. The measured internal dB(A) levels with the windows open exceed published classroom noise criteria values; however, for the windows closed case they are in general agreement with the criteria values.

74N186G0# ISSUE 10 PAGE 1123 CATEGORY 2 RPT#: NASA-TN-D-7462 L9293 74,04/08 30 PAGES UNCLASSIFIED DOCUMENT

UTL: Flight investigation of effects of a fan-in-fin yaw control concept on helicopter flying-quality characteristics

AUTH: A/REELLY, H. L.; B/KEST, T. C.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AVAIL: NTIS SAP: HC $3.25
Washington Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

MAJS: /AERODYNAMIC CONFIGURATIONS/DIRECTIONAL CONTROL/HELICOPTER CONTROL/HELICOPTER PERFORMANCE

MINS: /FLUCTED FANS/FLIGHT TESTS/HELICOPTER DESIGN/YAWING MOMENTS

ABA: Author

ABS: Flight-test results which describe flying-quality fan-in-fin yaw control system utilizing a pre-production version of a European helicopter are presented. Design compromises to be considered with this concept are also presented. The large, fixed vertical fin associated with the fan-in-fin system was helpful in maneuvering flight, but introduced several flying-quality problems when combined with the fan.

74N17768# ISSUE 9 PAGE 1007 CATEGORY 2 RPT#: NASA-TM-X-3016 L-9430 74,03/00 36 PAGES UNCLASSIFIED DOCUMENT

UTL: Wind tunnel investigation of simulated helicopter engine exhaust interacting with windstream

AUTH: A/SHAW, C. S.; B/WILSON, J. C.
CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AVAIL: NTIS SAP: HC $3.25

Film Supplement Number L-1139 to this report is available on request from NASA. Langley Res. Center Attn: Photographic Branch, Mail Stop 171, Hampton, Va. 23665
Washington Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

MAJS: /EXHAUST FLOW SIMULATION/HELICOPTER ENGINES/WIND TUNNEL TESTS

MINS: /FLOW DEFLECTION/FLOW VISUALIZATION/HEAT TRANSFER/WIND (METEOROLOGY)

ABA: Author

ABS: A wind tunnel investigation of the windstream-exhaust engine exhaust flow interaction on a light observation helicopter model has been conducted in the Langley V/STOL tunnel. The investigation utilized flow visualization techniques to determine the cause to
determine the cause of exhaust shield overheating during cruise and to find a means of eliminating the problem. A flow deflector located on the model cowling upstream of the exhaust mufflers and addition to aerodynamic shield fairings provided the best solution. Also evaluated was heat transfer concept employing pin fins to cool future exhaust hardware. The primary flow visualization technique used in the investigation was a newly developed system employing neutrally buoyant helium-filled bubbles. The resultant flow patterns were recorded on motion picture film and on television magnetic tape.

77N16675# ISSUE 7 P-U 925 CATEGORY 48 RPT# NASA-CP-2003 74/00/00 376 PAGES UNCLASSIFIED DOCUMENT

TITLE: Free Drifting Buoy

MAJ5: *BUOYS/OPTICAL TRACKING/RADAR TRACKING/TRACKING RADAR MINS: /CONFERENCES/DISPLAY DEVICES/ SATELLITE TRACKING/SONAR

ABA: Author
ABS: Information was exchanged between people directly involved with the development, use, and/or potential use of free-drifting buoys. Tracking systems and techniques, where methods and accuracy of optical, radio, radar, satellite, and sonic tracking of free-drifting buoys were discussed. Deployment and retrieval covering methods currently used or planned in the deployment and retrieval of free-drifting buoys from boats, ships, helicopters, fixed platforms, and fixed-wing aircraft were reported. Simulation, sensors, and data emphasizing the status of water circulation modeling, and sensors useful on free-drifting buoys, and data dispaly and analysis were described.

73N31623# ISSUE 22 PAGE 2700 CATEGORY 23 RPT#: NASA-TN-D-7309 L-BQ80 73/10/00 73 PAGES UNCLASSIFIED DOCUMENT

UTTI: An improved method for design of expansion-chamber mufflers with application to an operational helicopter
UNDC: Design and characteristics of expansion chamber

mufflers for reducing exhaust noise generated by helicopters

AUTH: A/ROBBINS T. L.
CORP: National Aeronautics and Space Administration. Langley Research Center. Hampton, Va. AVAIL.NTIS SAP: NC $3.50

WASHINGTON

MAJ5: /ENGINE NOISE/EXHAUST SYSTEMS/HELICOPTER ENGINES/
MINS: /ACUSTIC PROPERTIES/ AIRCRAFT EQUIPMENT/ SYSTEMS ANALYSIS

ABA: Author
ABS: An improved method for the design of expansion-chamber mufflers is described and applied to the task of reducing exhaust noise generated by a helicopter. The method is an improvement of standard transmission-line theory in that it accounts for the effect of the mean exhaust-gas flow on the acoustic-transmission properties of a muffler system, including the termination boundary condition. The method has been computerized, and the computer program includes an optimization procedure that adjusts muffler component lengths to achieve a minimum specified desired transmission loss over a specified frequency range. A printout of the program is included together with a user-oriented description.

82N72162# CATEGORY 5 RPT#: NASA-322-B-85C66 73/02/23 74 PAGES UNCLASSIFIED DOCUMENT

UTTI: NASA/Army rotor systems research aircraft project plan
CORP: National Aeronautics and Space Administration. Langley Research Center. Hampton, Va. AVAIL.NTIS

MAJ5: /AIRCRAFT DESIGN/PROJECT PLANNING/RESEARCH AIRCRAFT MINS: /AIRCRAFT CONFIGURATIONS/ DYNAMIC STRUCTURAL ANALYSIS/FLIGHT CONTROL/ WIND TUNNEL TESTS

73N21044# ISSUE 12 PAGE 1361 CATEGORY 2 CNT#: NASA-CR-362 73/02/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTI: A comprehensive unsteady theory for helicopter rotors
UNOC: Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight and under compressible flow conditions
tech.}

An aerodynamic theory is presented which allows the determination of the unsteady aerodynamic loading on a reference section of a helicopter rotor blade in axial or hovering flight under compressible flow conditions. The aerodynamics of the two-dimensional flow model are formulated using a kernel function approach. By introducing the acceleration potential the governing integral equation for the flow and its attendant downwash boundary condition are developed and solved numerically using the pressure mode assumption and a collocation technique. The compressible aerodynamic theory thus developed is compared analytically with two other existing theories, one incompressible and one compressible, and is shown to agree with these theories provided that the appropriate limit is taken so that the flow models agree. The ratio of blade oscillatory frequency to rotor rotational frequency is shown to be the correlation parameter between the two flow models.
UUTLI: Ground noise measurements during flyover, landing, and take-off operations of a standard and modified HH-43B helicopter

UNON: Field noise measurements of HH-43B helicopters during flight to determine effects of modifications on noise reduction

AUTH: A/HILTON, D. A.; B/HENDERSON, H. R.; C/PEGG, R. J.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS Washington

MAUS: /AERODYNAMIC NOISE/HH-43 HELICOPTER/NOISE REDUCTION

MINS: /AIRCRAFT NOISE/NOISE REDUCTION/PATENTS/SYSTEMS ENGINEERING/TIP SPEED/VIBRATION/VORTICES

ABA: Official Gazette of the U.S. Patent Office

ABS: A field noise measurement program has been conducted on a standard HH-43B helicopter, and one that had been modified by reducing the rotor speed, altering rotor tip shape, and treating the engine exhaust and inlet to reduce the external noise levels. The modifications were limited to those which could easily be made on a standard helicopter, consequently, only modest noise reductions were expected. The ground noise characteristics of each helicopter during flyby, hover, landing, and take-off operations are presented. Based on an analysis of the measured results, the overall noise levels of the modified helicopter was approximately 3 dB lower than that of the standard helicopter. Narrow-band-spectra data of the hovering helicopter showed a reduction in the noise from the -R explain due to the engine exhaust and a general reduction in low frequency content throughout the spectrum for the modified helicopter. The noise results of the data were found to correlate generally with previous noise measurements on this type of aircraft, and the noise reductions are within a range expected from the modifications which were incorporated.
ICING REQUIREMENTS FOR COMMERCIAL AIRCRAFT, LIGHT TRANSPORT AND GENERAL AVIATION AIRCRAFT, AND ROTORCRAFT WERE STUDIED. THE OBJECTIVES WERE TO:

- Establish the state of the art in aircraft icing,
- Determine the aircraft industry's icing research and technology needs, and
- Recommending both short and long-term icing programs to NASA. It is shown that all three categories of aircraft need improved and new ice protection systems. Icing calculation techniques, icing performance sensitivity on current and modern airfoils, and new and improved icing facilities. The need for a general aviation pilot training film concerning flight into icing conditions is also identified.

B2H15040/# ISSUE 6 PAGE 722 CATEGORY 7 RPT#: NASA-TP-1945 E-556 81/12/00 40 PAGES UNCLASSIFIED DOCUMENT

UTTL: Effect of fuel injector type on performance and emissions of reverse-flow combustor

AUTH: A/NO10EN. C. T.; B/RIDLEBAQH. S. M.
CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAL.NTSI SAP: AV-24990

MAJS: /COMBUSTION CHAMBERS/FUEL INJECTION/GAS TURBINE ENGINES/PERFORMANCE TESTS

MINS: /ENGINE TESTS/HELIICOPTERS/INJECTORS/JET ENGINES

ABA: Author

ABS: The combustion process in a reverse-flow combustor suitable for a small gas turbine engine was investigated to evaluate the effect of fuel injector type on performance and emissions. The fuel injector configurations using pressure-atomizing, swirl, flow, air blast, and air-assist techniques were compared and evaluated on the basis of performance obtained in a full-scale experimental combustor operated at inlet conditions corresponding to takeoff, cruise, low power, and idle and typical of a 16:1 pressure-ratio turbomine engine. Major differences in combustor performance and emissions characteristics were experienced with each injector type even though the aerodynamic configuration was common to most combustor models. Performance characteristics obtained with the various fuel injector types were not predicted from bench-test injector spray characteristics. The effect of the number of operating fuel injectors on performance and emissions is also presented.
Comparison of predicted engine core noise with proposed FAA helicopter noise certification requirements

AUTH: A/VOGNAHN, U.; B/GROESEBECK, D. PAA: B/(NASA, Lewis Research Center, Cleveland, OH)
CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MAJS: *CERTIFICATION/*ENGINE NOISE/*HELICOPTER ENGINES/*NOISE INTENSITY/*NOISE PREDICTION (AIRCRAFT)
MINS: /NOISE POLLUTION/NOISE REDUCTION/NOISE SPECTRA
ABA: (Author)
ABS: Calculated engine core noise levels, based on NASA-Lewis prediction procedures, for five representative helicopter engines are compared with measured total helicopter noise levels and proposed FAA helicopter noise certification requirements. Comparisons are made for level flyover and approach procedures. The measured noise levels are generally greater than those predicted for the core noise levels, except for the Sikorsky S-61 and S-64 helicopters. However, the predicted engine core noise levels are generally at or within 3 dB of the proposed FAA noise rules. Consequently, helicopter engine core noise can be a significant contributor to the overall helicopter noise signature and, at this time, will provide a limiting floor to a further decrease in future noise regulations.

B/C/S0629# ISSUE 17 PAGE 3002 CATEGORY 71
17/05/00 17 PAGES UNCLASSIFIED DOCUMENT

UTTL: Pneumatic deicer boots for helicopter rotor blades were tested. The tests were conducted in the 6 by 9 ft. ice research tunnel on a stationary section of a UH-1H helicopter main rotor blade. The boots were effective in removing ice and in reducing aerodynamic drag due to ice.

B/C/S059# ISSUE 10 PAGE 1297 CATEGORY 3
01/03/00 19 PAGES UNCLASSIFIED DOCUMENT

UTTL: Comparison of predicted engine core noise with proposed FAA helicopter noise certification requirements

AUTH: A/VOGNAHN, U.; B/GROESEBECK, D. E.
CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
Available SAP: HC A17/3 A21

MAJS: *AIRCRAFT ENGINES/*GENERAL AVIATION AIRCRAFT/*MILITARY AIRCRAFT/*NASA PROGRAMS/*PROPULSION SYSTEM CONFIGURATIONS/*RESEARCH AND DEVELOPMENT
MINS: /AIR POLLUTION/NOISE REDUCTION/TECHNOLOGY UTILIZATION
ABA: (Author)
ABS: Calculated engine core noise levels, based on NASA-Lewis prediction procedures, for five representative helicopter engines are compared with measured total helicopter noise levels and proposed FAA helicopter noise certification requirements. Comparisons are made for level flyover and approach procedures. The measured noise levels are generally at or within 3 dB of the proposed FAA noise rules. Consequently, helicopter engine core noise can be a significant contributor to the overall helicopter noise signature and, at this time, will provide a limiting floor to a further decrease in future noise regulations.
significantly greater than those predicted for the core noise levels, except for Sikorsky S-61 and S-64 helicopters. However, the predicted engine core noise levels are generally at or within 3 db of the proposed FAA noise rules. Consequently, helicopter core noise can be a significant contributor to the overall helicopter noise signature and, at this time, will provide a limiting factor to a further decrease in future noise regulations.

MINS: / HIGH SPEED/ OPTIMIZATION/ ROTATING SHAFTS /
TEMPERATURE PROFILES/ THRUST LOADS

ABA: A T

ABS: The temperature distribution and bearing heat generation of 120.65 mm bore high-speed tapered roller bearings was determined at shaft speeds of 20,000 rpm under simultaneous thrust and radial loads. The temperatures and thermal outputs were computed as functions of shaft speed, loading lubricant flow rates, and lubricant inlet temperatures. Bearing temperatures and heat generation were considerably lower than in standard bearings. Cup cooling was effective in lowering cup temperatures to levels of core temperatures.

BIA16627# ISSUE 6 PAGE 896 CATEGORY 37 RPT#:
ASME PAPER 80-C2/LUB-1B 08/08/00 8 PAGES
UNCLASSIFIED DOCUMENT
UTILT: Performance of computer-optimized tapered-roller
bearings to 2.4 million DN
AUTH: A/PARKER, R. J.; B/PELLET, S. J.; C/GRAND, E. R.
PAA: A/(NASA Lewis Research Center, Cleveland, Ohio),
B/(Industrial Tactecns, Inc., Compton, Calif.)
CORP: National Aeronautics and Space Administration, Lewis
Research Center, Cleveland, Ohio; Industrial
Tactecns, Inc., Compton, Calif.; SAP: MEMBERS.
$1.50; NONMEMBERS, $3.00
American Society of Mechanical Engineers and American
Society of Lubrication Engineers, Century 2
International Lubrication Conference, San Francisco,
MINS: /AIRCRAFT PARTS/ ANGULAR ACCELERATION/ COMPUTERIZED
DESIGN/ HELICOPTER PROPELLER DRIVE/ LOAD TESTS/ ROLLER BEARINGS
Evaluation of power transmission shafting for high-speed balancing has shown that when axial torque is applied, the imbalance response is altered. An increase in synchronous excitation always occurs if the axial torque level is altered from the value used during balancing; this was the case even when the shaft was balanced with torque applied. The twisting of the long slender shaft produces a change in the imbalance distribution sufficient to disrupt the balanced state. This paper presents a review of the analytic development of a weighted least squares approach to influence coefficient balancing and a review of experimental results. The analytic approach takes advantage of the fact that the past testing has shown that the influence coefficients are not significantly affected by the application of axial torque. The 3.60-m (12-ft) long aluminum shaft, 7.62 cm (3 in.) in diameter was run through the first flexural critical speed at torque levels ranging from zero-torque to 503.8 N·m (8000 lb-in.) in 112.9 N·m (1000 lb-in.) increments. Good comparison was achieved between predicted and experimental results.

The expressed needs and priorities of the civil helicopter users, the existing research efforts, and technology requirements as perceived by leading airframe and engine manufacturers were addressed, compared, and evaluated. Specifically, the observations and conclusions of these areas as they relate to the helicopter propulsion system are reported.

BON18043* ISSUE 9 PAGE 1094 CATEGORY 7 RPT#: NASA-TM-1416 E-335 80/00/00 10 PAGES UNCLASSIFIED DOCUMENT

AUTH: Aeropropulsion in year 2000
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC A02/MF A01
MAJS: AIRCRAFT ENGINES, CIVIL AVIATION, TECHNOLOGICAL FORECASTING
MINS: HELICOPTERS, SHORT HAUL AIRCRAFT, SUPERSONIC AIRCRAFT, TURBOPROP ENGINES

A sampling of probable future engine types, such as convertible engines for helicopters, turboprops for fuel-conservative airliners, and variable-cycle engines for supersonic transports are presented. Related technology improvements in propellers, materials, noise suppression, etc. are reviewed.

BON16342* ISSUE 7 PAGE 860 CATEGORY 37 RPT#: NASA-TM-8144 E-332 80/00/00 29 PAGES UNCLASSIFIED DOCUMENT

AUTH: R. E. S.
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC A03/MF A01
MAJS: HIGH SPEED, OPTIMIZATION, PERFORMANCE TESTS, ROLLER BEARINGS
MINS: COOLING, HELICOPTERS, LOADING (FORCES), LUBRICATION, TEMPERATURE DISTRIBUTION, TRANSMISSIONS, MACHINE ELEMENTS

The performance of 120.65 mm bore high speed design tapered roller bearings was investigated at shaft speeds to 20,000 rpm under combined thrust and radial
load. The test bearing design was computer optimized
for high speed operation. Temperature distribution and
bearing heat generation were determined as a function
of shaft speed, radial and thrust loads, lubricant
flow rates, and lubricant inlet temperature. The
roller bearing operated successfully at shaft speeds
up to 20,000 rpm under heavy thrust and radial loads.
Cup cooling was effective in decreasing the high cup
temperatures to levels equal to the cone temperature.

80A13068# ISSUE 2 PAGE 226 CATEGORY 37
79/11/00 17 PAGES UNCLASSIFIED DOCUMENT
UTIL: NASA gear research and its probable effect on
rotorcraft transmission design
AUTH: R/2AZETSKY, E. V.; B/TOWNSEND, D. P.; C/COY, J. J.
PAA: C/INASA. Lewis Research Center. Cleveland, Ohio
CORP: National Aeronautics and Space Administration. Lewis
Research Center. Cleveland. Ohio
American Helicopter Society. Meeting on Helicopter
Paper. 17 p.
MAJS: /GEAR TEETH/GEARS/HELICOPTER DESIGN/*NASA PROGRAMS
*/PRODUCT DEVELOPMENT/*TRANSMISSIONS (MACHINE
ELEMENTS)
MINS: /DURABILITY/DYNAMIC STRUCTURAL ANALYSIS/GRAPHS
(CHARTS)/HELICOPTER PROPELLER DRIVE/LUBRICATION/
MECHANICAL DRIVES/PERFORMANCE TESTS/SERVICE LIFE
ABA: M.E.P.
ABS: The NASA Lewis Research Center devised a comprehensive
gear technology research program beginning in 1969.
the results of which are being integrated into the
NASA civilian Helicopter Transmission System
Technology Program. Attention is given to the results
of this gear research and these programs which are
presently being undertaken. In addition, research
programs involving fatigue, friction, and process
life prediction methods. gear design and dynamics.
elastohydrodynamic lubrication, lubrication
methods and gear noise are presented. Finally.
the impact of advanced gear research technology on
rotorcraft transmission design is discussed.

79A39805# ISSUE 16 PAGE 3006 CATEGORY 37
79/06/00 4 PAGES UNCLASSIFIED DOCUMENT
UTIL: Diagnostics of wear in aeronautical systems
AUTH: A/WEDDEVEN. L. D. PAA: A/INASA. Lewis Research
Center. Cleveland. Ohio
CORP: National Aeronautics and Space Administration. Lewis
Research Center. Cleveland. Ohio
American Chemical Society. State-of-the-Art Symposium
MAJS: /ENGINE DESIGN/GAS TURBINE ENGINES/HELICOPTER
ENGINES
MINS: /COMPONENT RELIABILITY/COOLING SYSTEMS/GUIDE VANE/
PREDICTION ANALYSIS TECHNIQUES/SERVICE LIFE/
STRUCTURAL DESIGN/TURBINE BLADES
ABA: A.T.
ABS: Advances in materials. coatings. turbine cooling
technology. structural and design concepts. and
cost/weight advantage in the design of helicopter
gas turbine engine components are presented.
Stationary parts including the inlet particle
separators, the front frame, rotor tip seals, vanes and combustors and rotating components - compressor
blades, disks, and turbine blades - are discussed. Advanced composite materials are considered for the
front frame and compressor blades. pre-alloyed powder superalloys will increase strength and reduce costs of
disks, the oxide dispersion strengthened alloys will have 100C higher temperature in combustors and
vanes than conventional superalloys. ceramics will provide the highest use temperature of 1400C for
stator vanes and 1370C for turbine blades, and directionally solidified eutectics will afford up to
500C temperature advantage at turbine blade operating
conditions. Coatings for surface protection at higher
surface temperatures and design trends in turbine
cooling technology are discussed. a new analytical
method of life prediction such as strain gage
partitioning for high temperature prediction, fatigue
life, computerized prediction of oxidation resistance,
and advanced techniques for estimating coating life
are described.

BON1527* ISSUE 6 PAGE 701 CATEGORY 7 RPT:
NASA-CP-2077 E-9906 79/00/00 426 PAGES
UNCLASSIFIED DOCUMENT

UTFL: Quiet powered-lift propulsion
CORP: National Aeronautics and Space Administration, Lewis
Research Center, Cleveland, Ohio. AVAILABLE SAP:
HC A19/MF A01

Conf. held at Cincinnati, Ohio, 14-15 Nov. 1978
MAJS: /C-15 AIRCRAFT/CONFERENCE/ NASA PROGRAMS/PWRD
LIFT AIRCRAFT/ QUIET ENGINE PROGRAM/ TILT ROTOR
AIRCRAFT/ YC-14 AIRCRAFT

MIN$: / ARMED FORCES (UNITED STATES)/ PROLUSION SYSTEM
PERFORMANCE/ RESEARCH AIRCRAFT/ TECHNOLOGY ASSESSMENT

ABA: R.E.S.

ABS: Recent results of programs exploring new propulsion
research for powered-lift aircraft systems are
presented. Topics discussed include results from the
'quiet clean short-haul experimental engine' program
and progress reports on the 'quiet short-haul research
discription' and 'tilt-rotor research aircraft' program.
In addition to these NASA programs, the Air Force AMST
YC 14 and YC 15 programs were reviewed.

BON10213* ISSUE 1 PAGE 2B CATEGORY 7 79/00/00
36 PAGES UNCLASSIFIED DOCUMENT

UTFL: Mechanical components
AUTH: A/ANDERSON, W. J.; B/BILL, R. C.; C/COY, J. J.;
D/FLEMMING, D. P.
CORP: National Aeronautics and Space Administration, Lewis
Research Center, Cleveland, Ohio. AVAILABLE SAP:
HC A07/MF A01

Workshop held at Cleveland, 19-21 Jul. 1978
MAJS: / AIRCRAFT HAZARDS/ CONFERENCE/ ICE FORMATION

MIN$: / HELICOPTERS/ METEOROLOGY/ SAFETY MANAGEMENT

79N33477* ISSUE 24 PAGE 3215 CATEGORY 37
RPT: NASA-TP-79292 E-236 79/00/00 19 PAGES
UNCLASSIFIED DOCUMENT

UTFL: NASA gear research and its probable effect on
rotorcraft transmission design
AUTH: A/ZARETSKY, E. V.; B/TOWNSEND, D. P.; C/COY, J. J.
CORP: National Aeronautics and Space Administration, Lewis
Research Center, Cleveland, Ohio. AVAILABLE SAP:
HC A02/MF A01

Presented at the Meeting on Helicopter Propulsion
Systems, Williamsburg, Va., 6-8 Nov. 1979; sponsored
by Am. Helicopter Soc.

MAJS: / MECHANICAL DRIVES/ NASA PROGRAMS/ ROTARY WING
AIRCRAFT/ TECHNOLOGY TRANSFER

MIN$: / ELASTOHYDRODYNAMICS/ LIFE (DURABILITY)/ LUBRICATION/
NOISE (SOUND)/ STEELS/ STRUCTURAL ENGINEERING

ABA: M.M.M.

ABS: The results of the NASA gear research is reviewed as
well as those programs which are presently being
undertaken. Research programs studying pitting
fatigue, gear steels and processing, life prediction
methods, gear design and dynamics, elastohydrodynamic
lubrication, lubrication methods and gear noise are
presented. The impact of advanced gear research
technology on rotorcraft transmission design is
discussed.

79N23912* ISSUE 15 PAGE 1926 CATEGORY 2 RPT:
NASA-CP-2086 FAA-RD-78-109 E-027 79/00/00 147 PAGES
UNCLASSIFIED DOCUMENT

UTFL: Aircraft icing
AUTH: A/BLAHA, B. J.; PAT: A/COMP.
CORP: National Aeronautics and Space Administration, Lewis
Research Center, Cleveland, Ohio. AVAILABLE SAP:
HC A07/MF A01

Workshop held at Cleveland, 19-21 Jul. 1978
MAJS: / AIRCRAFT HAZARDS/ CONFERENCE/ ICE FORMATION

MIN$: / HELICOPTERS/ METEOROLOGY/ SAFETY MANAGEMENT

TERMINAL 20 PAGE 6 (ITEM 18-21 OF 39)
ANN: The results of a conference on the problems of aircraft icing are reported. For individual titles, see N79-23913 through N79-23919.

79N20008*# ISSUE 11 PAGE 1375 CATEGORY 1 RPT#: NASA-TM-79100 ARAA6COM-TR-79-4 79/00/00 65 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Materials and structural aspects of advanced gas-turbine engines

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAILABLE SAP: HC A04/MF A01
To be presented at the Intern. Congr. in Aeron., Paris, 6-8 Jun. 1979

MAJS: /ENGINE PARTS/ +GAS TURBINE ENGINES/ +HELICOPTER DESIGN
/REFRACTORY MATERIALS/ +STRUCTURAL DESIGN

MINS: / CERAMICS/ COATING/ + COMBUSTION CHAMBERS/ COMPOSITE MATERIALS/ CORROSION/ THERMAL FATIGUE/ TURBINE BLADES

ABA: A.R.H

ABS: The key to improved helicopter gas turbine engine performance lies in the development of advanced materials and advanced structural and design concepts. The modification of the low temperature components of helicopter engines (such as the inlet particle separator), the introduction of composites for use in the engine front frame, the development of advanced materials with increased use-temperature capability for the engine hot section, can result in improved performance and/or decreased engine maintenance cost.

A major emphasis in helicopter engine design is the ability to design to meet a required lifetime. This, in turn, requires that the interrelated aspects of higher operating temperatures and pressures, cooling concepts, and environmental protection schemes be integrated into component design. The major material advances, coatings, and design life-prediction techniques pertinent to helicopter engines are reviewed; the current state-of-the-art is identified; and when appropriate, progress, problems, and future directions are assessed.

79N15558*# ISSUE 7 PAGE 819 CATEGORY 7 RPT#: NASA-TM-79075 E-9892 79/00/00 24 PAGES UNCLASSIFIED DOCUMENT

UTTLE: The gate studies: Assessing the potential of future small general aviation turbine engines

AUTH: A/STRAK, W. C
CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAILABLE SAP: HC A02/MF A01

MAJS: /GENERAL AVIATION AIRCRAFT/ TURBINE ENGINES
MINS: / AIRFRAMES/ +COSTS/ ENGINE PARTS/ HELICOPTERS/ MARKETING/ TURBOFAN ENGINES

ABA: J.A.M

ABS: Four studies were completed that explore the opportunities for future General Aviation turbine engines (GATE) in the 150-1000 SHP class. These studies forecasted the potential impact of advanced technology turbine engines in the post-1985 market. Important engine aircraft and missions, desirable engine sizes, engine performance, and cost goals. Parametric evaluations of various engine cycles, configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis. Both fixed-wing and helicopter
a aircraft, and turboshaft, turboprop, and turbofan engines were considered. Sizable performance gains (e.g., 20% SFC decrease) and large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class were predicted.

78N16055* ISSUE 7 PAGE 844 CATEGORY 7 RPT#: NASA-TM-73831 78/00/00 21 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/STEWART, W. L.; B/JOHNSON, H. W.; C/WEBER, R. J.
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC 403/MF A01
Presented at the 16th Aerospace Sci. Meeting, Huntsville, Ala., 16-18 Jan.; sponsored by AIAA

MAJS: / CIVIL AVIATION/ JET PROPULSION/ NASA PROGRAMS/
VARIABLE CYCLE ENGINES
MINS: / ENERGY CONSERVATION/ FUEL CONSUMPTION/ SUPERSONIC AIRCRAFT/ TURBOFAN ENGINES

ABSTRACT

A review of five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed. Included are programs directed at exploring propulsion system concepts for (1) energy conservation subsonic aircraft (improved current turbosfans, advanced turboprops, and advanced turboprops); (2) supersonic cruise aircraft (variable cycle engines); (3) general aviation aircraft (improved reciprocating engines and small gas turbines); (4) powered lift aircraft (advanced turbosfans); and (5) advanced rotorcraft.

77N32106* ISSUE 13 PAGE 1680 CATEGORY 7 RPT#: NASA-TM-X-3524 E-9026 77/05/00 35 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/SCHAEFER, J. W.; B/SAGERSER, D. R.; C/STAKOLICH, E. G.
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC 403/MF A01
Washington

MAJS: / BYPASSES/ HELICOPTER PROPELLER DRIVE/ THRUST REVERSAL/ VARIABLE PITCH PROPELLERS
MINS: / DYNAMIC TESTS/ PITCH (INCLINATION)/ PROPULSION SYSTEM CONFIGURATIONS

ABSTRACT

A study of NASA's high-bypass-engine thrust reversal using a variable-pitch fan

The test program demonstrated that successful and rapid forward-to-reverse-thrust transitions can be performed without any significant engine operational limitations for fan blade pitch changes through either feather pitch or flat pitch. For a feather-pitch operation with a flight inlet, fan stall problems were encountered, and a fan blade overshoot technique was used to establish reverse thrust.

77N33517* ISSUE 24 PAGE 3224 CATEGORY 37 RPT#: NASA-TM-X-73672 E-8825 77/00/00 29 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/PARKER, R. J.; B/SIGNER, H. R.; PAA: E/(Industrial Research, Inc.)
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC 403/MF A01

Presented at the Joint Lubrication Conf., Kansas City, 3-5 Oct. 1977; sponsored by ASLE and ASME

MAJS: / GEARINGS/ LUBRICATION/ LUBRICATION SYSTEMS/ ROLLER BEARINGS
MINS: / HELICOPTERS/ LUBRICATIONS/ TRANSMISSIONS (MACHINE ELEMENTS)

ABSTRACT

Steady-state unbalance response of a three-disk rotor on flexible, dampened supports

AUTH: A/CUNNINGHAM, R. E.
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC 403/MF A01

Presented at the Vibrations Conf., Chicago, 26-29 Sep. 1977; sponsored by ASME

MAJS: / BALL BEARINGS/ DAMPERS (VALVES)/ ROTORS/ STEADY STATE/ VIBRATION ISOLATORS
MINS: / DAMPING/ FUEL CONSUMPTION/ HELICOPTERS/ STRUCTURAL VIBRATION/ TURBOSHATS

ABSTRACT

Experimental data are presented for the unbalance response of a flexible, ball-bearing supported rotor to speeds above the third lateral bending critical. Values of squeeze film damping coefficients obtained from measured data are compared to theoretical values obtained from short bearing approximation over a frequency range from 5000 to 30 000 cycles/min. Experimental response for an undamped rotor is compared to that of one having oil squeeze film dampers at the bearings. Unbalance applied varied from 0.62 to 15.1 gm-cm.

77N33517* ISSUE 24 PAGE 3224 CATEGORY 37 RPT#: NASA-TM-X-73672 E-8825 77/00/00 29 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/PARKER, R. J.; B/SIGNER, H. R.; PAA: E/(Industrial Research, Inc.)
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS SAP: HC 403/MF A01

Presented at the Joint Lubrication Conf., Kansas City, 3-5 Oct. 1977; sponsored by ASLE and ASME

MAJS: / GEARINGS/ LUBRICATION/ LUBRICATION SYSTEMS/ ROLLER BEARINGS
MINS: / HELICOPTERS/ LUBRICATIONS/ TRANSMISSIONS (MACHINE ELEMENTS)

ABSTRACT

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AUTH: A/CUNNINGHAM, R. E.
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Presented at the Vibrations Conf., Chicago, 26-29 Sep. 1977; sponsored by ASME

MAJS: / BALL BEARINGS/ DAMPERS (VALVES)/ ROTORS/ STEADY STATE/ VIBRATION ISOLATORS
MINS: / DAMPING/ FUEL CONSUMPTION/ HELICOPTERS/ STRUCTURAL VIBRATION/ TURBOSHATS

ABSTRACT

Experimental data are presented for the unbalance response of a flexible, ball-bearing supported rotor to speeds above the third lateral bending critical. Values of squeeze film damping coefficients obtained from measured data are compared to theoretical values obtained from short bearing approximation over a frequency range from 5000 to 30 000 cycles/min. Experimental response for an undamped rotor is compared to that of one having oil squeeze film dampers at the bearings. Unbalance applied varied from 0.62 to 15.1 gm-cm.
ABS: The performance of 120.65-mm (4.75-in.-) bore tapered-roller bearings was investigated at shaft speeds up to 15,000 rpm (18,000 DN). Temperature distribution and bearing heat generation were determined as a function of shaft speed, radial and thrust loads, lubricant flow rate, and lubricant inlet temperature. Lubricant was supplied either by jets or by impingement of holes through the cone directly to the cone-rib contact and jets at the roller small-end side. Cone-rib lubrication significantly improved high-speed tapered-roller bearing performance, yielding lower cone-face temperatures and lower power loss and allowing lower lubricant flow rates for a given speed condition. Bearing temperatures increased with increased shaft speed and decreased with increased lubricant flow rate. Bearing power loss increased with increased shaft speed and increased lubricant flow rate.

76A43148** ISSUE 22 PAGE 3465 CATEGORY 37
76/05/06 35 PAGES UNCLASSIFIED DOCUMENT

UTIL: Evaluation of ball and roller bearings restored by grinding

AUTH: A/PARKER, R. J.; B/ZARETSKY, E. V.; C/CHEN, S. M.
PAA: B/(NASA, Lewis Research Center, Cleveland, Ohio)
C/NAAS Lewis Research Center, Cleveland, Ohio: U.S. Army, Aviation Systems Command, St. Louis, Mo.)
CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MAJS: /ENGINE BEARINGS//ENGINE PARTS//FATIGUE TESTS//MECHANICAL DRIVES//METAL GRINDING//ROLLER BEARINGS//TURBINE ENGINES

MINS: /BOUNDARY LUBRICATION//ELASTOHYDRODYNAMICS//FAILURE ANALYSIS//HELICOPTER ENGINES//INSPECTION//QUALITY CONTROL//RESTORATION//SHEAR STRESS//SURFACE FINISHING//UH-1 HELICOPTER

ABA: (Author)

ABS: A joint program was undertaken to restore by grinding those rolling-element bearings which are currently being discarded at aircraft engine and transmission overhaul. Three bearing types were selected from the UH-1 helicopter engine (T-53) and transmission for the pilot program. Groups of each of these bearings were visually and dimensionally inspected for suitability for restoration. A total of 250 bearings were restored by grinding. Of this number, 30 bearings from each type were endurance tested to a TBD of 1600 hours. No bearing failures occurred related to the restoration by grinding process. The two bearing failures which occurred were due to defective rolling elements and were typical of those which may occur in new bearings. The restorable component yield to the three groups was in excess of 90 percent.

76N23582** ISSUE 14 PAGE 1803 CATEGORY 37
RPT: NASA-TM-X-71802 E-8678 76/05/00 19 PAGES
UNCLASSIFIED DOCUMENT

UTIL: Oil or mist lubrication as an emergency system and as a primary lubrication system --- for helicopter engines

AUTH: A/LOOMIS, W. R.
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL:NITIS SAP: HC $3.50
MAJS: /BEARINGS//HELICOPTER ENGINES//LUBRICATION SYSTEMS
MINS: /AIR COOLING//AIRCRAFT SAFETY//EMERGENCIES//HEAT GENERATION//MIST//VORTEX GENERATORS
ABA: Author

ABS: The feasibility of an emergency aspirator once-through lubrication system was demonstrated as a viable survivability concept for Army helicopter mainshaft engine bearings for periods as long as 30 minutes. It was also shown in an experimental study using a 46-mm bore bearing test machine that an oil-air mist once-through system with auxiliary air cooling is an effective primary lubrication system at speeds up to 2,500,000 DN for extended operating periods of at least 50 hours.

76N16065** ISSUE 7 PAGE 802 CATEGORY 5 RPT:
NASA-TM-X-71867 E-8633 76/01/00 35 PAGES
UNCLASSIFIED DOCUMENT

UTIL: OH-58 helicopter transmission failure analysis

AUTH: A/TOWNSEND, D. P.; B/COY, J. J.; C/HAYANI, B. R.
PAA: B/Army Air Mobility Res. and Develop Lab., Cleveland
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL:NITIS SAP: HC $4.00
MAJS: /FAILURE ANALYSIS//HELICOPTER PROPPELLER DRIVE
MINS: /GAS COOLING//GEARS//HELICOPTER PERFORMANCE//LIQUID COOLING//LUBRICATING OILS//TORSIONAL STRESS
ABA: Author

ABS: The OH-58 main transmission gearbox was run at varying output torques, speeds, and oil cooling rates. The gearbox was subsequently run to destruction by draining the oil from the gearbox while operating at a speed of 6200 revs per minute and 36,000 inch-pounds output torque. Primary cause of gearbox failure was
overheating and melting of the planet bearing aluminum cages. Complete failure of the gearbox occurred in 28/2 minutes after the oil pressure dropped to zero. The alternating and maximum stresses in the gearbox top case were approximately 10 percent of the endurance limit for the material. Deflection of the bevel gear at 6700 C inch-pounds output torque indicate a marginal stiffness for the bevel gear supporting system.

7SA14872# ISSUE 4 PAGE 519 CATEGORY 37 RPT#: ASME PAPER 75-LUB-20 75/10/00 8 PAGES UNCLASSIFIED DOCUMENT

UTILITY: A life study of ausformed, standard forged, and standard machined AISI M-50 spur gears

AUTH: A/TOWNSEND, D. P.; B/ZARETSKY, E. V.; C/BAMBERGER, E. N. 

FAA: B/NASA, Lewis Research Center, Cleveland, Ohio; C/General Electric Co., Evendale, Ohio

CORP: General Electric Co., Evendale, Ohio; National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. SAP: MEMBERS: $1.50; NONMEMBERS: $3.00


MAJORS: /AIRCRAFT PARTS/ FATIGUE LIFE/GEAR TEETH/METAL WORKING/PERFORMANCE TESTS/ SERVICE LIFE

MINS: /AUSSFORMING/ FORGING/ HELICOPTERS/ METAL FATIGUE/

PHOTOMICROGRAPHY/ STEEL STRUCTURES

ABA: (Author)

ABS: Tests were conducted at 350 K with three groups of 8.9 cm pitch diameter spur gears made of vacuum-induction melted (VIM), vacuum-arc remelted (VAR), AISI M-50 steel and one group of vacuum-arc remelted (VAR) AISI 9310 steel. The pinting fatigue life of the standard forged and ausformed gears was approximately five times that of the VAR AISI 9310 gears and ten times that of the bending fatigue life of the standard machined VIM/VAR AISI M-50 gears run under identical conditions. There was a slight decrease in the 10-percent life of the ausformed gears from that for the standard forged gears. However, the difference is not statistically significant. The standard machined gears failed primarily by gear tooth fracture while the forged and ausformed VIM/VAR AISI M-50 and the VAR AISI 9310 gears failed primarily by surface pitting fatigue. The ausformed gears had a slightly greater tendency to fail by tooth fracture than the standard forged gears.

7SN33055# ISSUE 24 PAGE 3003 CATEGORY 7 RPT#: NASA-1M-X-71806 E-8496 75/09/00 20 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Development of circumferential seal for helicopter transmission: Results of bench and flight tests

AUTH: A/STROM, T. N.; B/LUDWIG, L. P.

CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS: SAP: HC $3.25

MAJORS: /FLIGHT TESTS/ HELICOPTER ENGINES/ LUBRICANTS/O RING SEALS/ SHAFTS (MACHINE ELEMENTS)

MINS: /FLIGHT SIMULATION/ PERFORMANCE PREDICTION

ABA: Author

ABS: A modified circumferential segmented ring seal was designed for direct replacement of a helicopter transmission elastomeric lip seal operating on a shaft diameter of 13.91 centimeters (5.481 in.) at sliding velocities to 52.48 m/sec (10 330 ft/min). The modifications involved the garter spring tension, shaft roundness, seal housing flatness, and pumping grooves to inhibit leakage. Operation of the seals in bench tests under simulated helicopter transmission conditions revealed that the seal leakage rate was within acceptable limits and that the wear rate was negligible. The low leakage and wear rates were confirmed in flight tests of 600 and 175 hours (sliding speed, 48.11 m/sec 9470 ft/min). An additional 200 hours of airworthiness qualification testing (aircraft tie down) demonstrated that the seal can operate at the advanced sliding conditions of 52.48 m/sec (10 330 ft/min).
costs for mission times up to just under 2 hours. At 2
hours and above, the regenerative turboshaft appears
promising. The reciprocating and rotary engines are
less attractive, requiring from 10 percent to 60
percent more aircraft to have the same total payload
capability as a given number of turbine powered craft.
A nomogram was developed for estimating total costs
of engines not covered in this study.

74N11204*# ISSUE 2 PAGE 159 CATEGORY 13 RPT#:
NASA-TM-X-71481 73/06/00 7 PAGES UNCLASSIFIED
DOCUMENT
UTIL: Airborne profiling of ice thickness using a short
pulse radar
AUTH: A/VICKERS, R. S.; B/HEIGHWAY. J. E.; C/EDNEY, R.
PAA: A/(Colo. State Univ.)
The acquisition and interpretation of ice thickness data from a mobile platform has for some time been a goal of the remote sensing community. Such data, once obtainable, is of value in monitoring the changes in ice thickness over large areas, and in mapping the potential hazards to traffic in shipping lanes. Measurements made from a helicopter-borne ice thickness profiler of ice in Lake Superior, Lake St. Clair and the St. Clair River as part of NASA's program to develop an ice information system are described. The profiler described is a high resolution, non-imaging, short pulse radar, operating at a carrier frequency of 2.7 GHz. The system can resolve reflective surfaces separated by as little as 10 cm, and permits measurement of the distance between resolvable surfaces with an accuracy of about 1 cm. Data samples are given for measurements both in a static (helicopter hovering), and a traversing mode. Ground truth measurements taken by an ice auger team traveling with the helicopter are compared with the remotely sensed data and the accuracy of the profiler is discussed based on these measurements.

72N26504# ISSUE 19 PAGE 2570 CATEGORY 15
RFP#: NASA-TM-X-68117  E-7050  72/00/00  13 PAGES
UNCLASSIFIED DOCUMENT

Design analysis of a nutating plate drive for 2500 horsepower helicopter gear box

Design analysis of nutating plate drive for 2500 horse power helicopter gear box

Design analysis of nutating plate drive for 2500 horse power helicopter gear box

A simplified design analysis was conducted on a nutating plate type drive system for a 2500 horsepower helicopter main rotor gear box. A drive system that split the output torque evenly between two nutating plates for the purpose of reducing the load on each nutating plate was analyzed. Needle bearings were used on the nutating plate pins. The results of the analysis indicated that the required load capacity of the pin bearings and the speed of the nutating plate bearings were beyond the state-of-the-art capacity of rolling-element bearings. The analysis further indicates that the nutating plate drive is less efficient, and results in a higher weight per horsepower than a conventional planetary helicopter transmission with similar design specifications.

MAJS: /AERODYNAMIC CHARACTERISTICS/FLIGHT TESTS/ROTARY WING AIRCRAFT

MINS: /AERODYNAMIC COEFFICIENTS/LOW PASS FILTERS/PRESSURE GRADIENTS

ABA: R.C.T.

ABS: Efforts were made to extend flight range of combat airplanes to high altitudes. The static and dynamic results obtained on a modern combat airplane with data wings are presented.

B2N19173# ISSUE 10 PAGE 1318 CATEGORY 2 RPT#: NASA-TM-84146 80/12/05 149 PAGES UNCLASSIFIED DOCUMENT

UTTL: NASA/HAA Advanced Rotorcraft Technology and Tiltrotor Workshops. Volume 4: Flight Control Avionics Systems and Human Factors

CORP: National Aeronautics and Space Administration, Washington, D.C. AVAL1NTIS SAP: HC AO7/MF AO1 Workshop held at Palo Alto, Calif. 2-5 Dec. 1980

MANS: /HELI COPTER DESIGN/HELI COPTER ENGINES/HELI COPTER PERFORMANCE/HELI COPTER/S SHORT TAKEOFF AIRCRAFT/ TECHNOLOGY ASSESSMENT/USER REQUIREMENTS

MINS: /CONFERENCES/PAPERS/PROCEEDINGS/RESEARCH/ROTARY WING AIRCRAFT/TILTING ROTORS

ABA: L.F.M.

ABS: This presentation provides an overview of the NASA Rotorcraft Program as an introduction to the technical sessions of the Advanced Rotorcraft Technology Workshop. It deals with the basis for NASA's increasing emphasis on rotorcraft technology. NASA's research capabilities, recent program planning efforts, highlights of its 10-year plan and future directions and opportunities.

B2N19172# ISSUE 10 PAGE 1317 CATEGORY 2 RPT#: NASA-TM-84147 80/12/04 285 PAGES UNCLASSIFIED DOCUMENT

UTTL: NASA/HAA Advanced Rotorcraft Technology and Tiltrotor Workshops. Volume 3: Aerodynamics and Structures Session


MANS: /AERODYNAMIC CHARACTERISTICS/CONFERENCES/HELI COPTER/HELI COPTER ENGINES/HELI COPTER PERFORMANCE/HELI COPTER/SHORT TAKEOFF AIRCRAFT/ TECHNOLOGY ASSESSMENT/USER REQUIREMENTS

MINS: /CONFERENCES/PAPERS/PROCEEDINGS/RESEARCH/ROTARY WING AIRCRAFT/TILTING ROTORS

ABA: L.F.M.

ABS: Helicopter user needs, technology requirements and status, and proposed research and development action are summarized. It is divided into three sections: flight dynamics and control; all weather operations; and human factors.

B2N19171# ISSUE 10 PAGE 1317 CATEGORY 2 RPT#: NASA-TM-84147 80/12/05 111 PAGES UNCLASSIFIED DOCUMENT

UTTL: NASA/HAA Advanced Rotorcraft Technology and Tiltrotor Workshops. Volume 2: Operating Views


MANS: /HELI COPTER DESIGN/HELI COPTER ENGINES/HELI COPTER PERFORMANCE/HELI COPTER/SHORT TAKEOFF AIRCRAFT/ TECHNOLOGY ASSESSMENT/USER REQUIREMENTS

MINS: /CONFERENCES/PAPERS/PROCEEDINGS/RESEARCH/ROTARY WING AIRCRAFT/TILTING ROTORS

ABA: R.U.F.

ABS: A special panel of helicopter users give presentations in 12 basic areas of helicopter applications. Development of the helicopter and the needs for future growth are discussed.
translation was announced as n79-19634
util: radiological examination of the spine and fitness for
work as a helicopter pilot
auth: a/delahaye, r. p.; b/auffret, r.; c/metagis, p. j.
corp: national aeronautics and space administration
washington, d. c. avail:ntis sap: hc ad2/mf ad1
transl. by kanner (leo) associates, redwood city,
calif. original coc prep. by aerospace research and
development, paris transl. into english of "examen
radiologique du rechis et aptitude a l'emploi de pilot
d'helicoptere" rep. agar-00-255. paris, dec. 1978
p 56-1-56-7
maj: /*aircraft pilots/flight fitness/physical
examinations/radiology/spine
mins: /*musculoskeletal system/qualifications/vertebrae/x
ray analysis
aba: author
abs: on the matter of spinal fitness for piloting,
standards are proposed that suit the critical spinal
segments proper to different jobs. involved here are
primarily pilots of combat airplanes and of
helicopters. fitness for one of these does not
necessarily mean fitness for the other.

translation was announced as n79-19656
util: vertebral pain in helicopter pilots
auth: a/auffret, r.; b/delahaye, r. p.; c/metagis, p. j.
corp: national aeronautics and space administration
washington, d. c. avail:ntis sap: hc ad2/mf ad1
transl. by kanner (leo) associates, redwood city,
calif. transl. into english of "les alleges de
vertebrales des pilotes d'helicopteres" rep.
agar-00-255. agarad, paris, dec. 1978
maj: /*aircraft pilots/clinical medicine/"helicopters/"pathology/"vertebral column
mins: /*causes/diseases/pathological effects/
physiological effects/signs and symptoms
aba: r. e. s.
abs: pathological forms of spinal pain engendered by
piloting helicopters were clinically studied.
lumbargia and pathology of the dorsal and cervical
spine are discussed along with their clinical and
radiological signs and origins.
program has the objective to explore and demonstrate advanced technology fuel preparation and combustion systems which produce very low emission levels, particularly with respect to the oxides of nitrogen, during high altitude cruising flight. Other programs considered include the Quiet, Clean, General Aviation Turboprop program, the Variable Cycle Engine Technology program, the Helicopter Transmission Technology program, the Broad Specification Turbofan engine program, the Engine Component Improvement program, the Advanced Turboprop Technology program, the Supersonic Cruise Propulsion Technology program, the Materials for Advanced Turbine Engines program, and the Aerelasticity of Turbine Engines program.

78A20651* ISSUE 7 PAGE 1121 CATEGORY 7 RPT#: NASA-PAP 78-43 78/01/00 14 PAGES UNCLASSIFIED DOCUMENT

UTILITY: A review of NASA's propulsion programs for civil aviation

AUTH: A/STEWART, W. L.; B/JOHNSON, H. W.; C/WEBER, R. J.

PAA: A/(NASA Lewis Research Center, Cleveland, Ohio); B/(NASA Aeronautical Propulsion Div., Washington, D.C.); C/(NASA Lewis Research Center, Mission Analysis Branch, Cleveland, Ohio)

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. National Aeronautics and Space Administration. Washington, D.C.


MAJS: /AIRCRAFT ENGINES/CIVIL AVIATION/ENGINE DESIGN/NASA PROGRAMS/PROPULSION SYSTEM PERFORMANCE

MINS: /AIRCRAFT DESIGN/ENERGY CONSERVATION/POWERED LIFT AIRCRAFT/RESEARCH AND DEVELOPMENT/SUBSONIC AIRCRAFT/SUPersonic AIRCRAFT/TURBOPROP AIRCRAFT

ABA: (Author)

ABS: Five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed. Included are programs directed at exploring propulsion system concepts for (1) energy-conservative subsonic aircraft (improved current turboprops, advanced turboprops, and advanced turboprops). (2) supersonic cruise aircraft (variable-cycle engines). (3) general aviation aircraft (improved reciprocating engines and small gas turbines). (4) powered lift aircraft (advanced turboprops). and (5) advanced rotorcraft. These programs reflect the opportunities for significant improvements in civil aviation through the application of advanced propulsion concepts.

78N10041* ISSUE 9 PAGE 1110 CATEGORY 5 RPT#: NASA-IM-75063 CNT#: NASA-2791 77/12/00 15 PAGES UNCLASSIFIED DOCUMENT

UTILITY: A new heliostat from SNIAS helicopter division

AUTH: A/MORISSETT, J.


MAJS: /HELICOPTER DESIGN/HELICOPTER PERFORMANCE/HIGH ALTITUDE BALLOONS

MINS: /Balloons/Heavy Lift Helicopters/PRODUCT DEVELOPMENT/STRUCTURAL DESIGN

ABA: Author

ABS: The Heliostat was described as a helicopter in which the vehicle weight is nullified by two balloons arranged in a catamaran fashion. Development of such a vehicle is discussed, and various uses for these helicopters are summarized.

78N11114* ISSUE 2 PAGE 150 CATEGORY 8 RPT#: NASA-TM-75161 DLR-DB-552-76/12 CNT#: NASA-2791 77/10/00 68 PAGES UNCLASSIFIED DOCUMENT

Original language document was announced as N77-21085

UTILITY: Concepts for the design of a completely active helicopter isolation system using output vector feedback

AUTH: A/SCHULZ, G.


MAJS: /COMPUTERIZED SIMULATION/FEEDBACK CONTROL/HELICOPTER DESIGN/OPTIMAL CONTROL/VIBRATION DAMPING

MINS: /BO-105 HELICOPTER/DIRECTIONAL CONTROL/ROTOR AERODYNAMICS/ROTOR BLADES (TURBOMACHINERY)

ABA: Author

ABS: The theory of output vector feedback (a few measured quantities) is used to derive completely active oscillation isolation functions for helicopters. These feedback controller concepts are tested with various versions of the BO 105 helicopter and their performance is demonstrated. A compensation of the vibrational excitations from the rotor and harmonics of the number of blades is considered. There is also a fast and automatic trim function for maneuvers.
78N17042* ISSUE B PAGE 976 CATEGORY 5 RPT#:
NASA-TM 75038 CNT#: NASW-2752 77/08/00 11 PAGES
UNCLASSIFIED DOCUMENT
Transcription was announced as A77-26913

UTL: Aerospacel is ready to develop a convertible plane with tethering rotors
AUTH: A/MORISSET, J.

CORP: National Aeronautics and Space Administration, Washington, D.C. AVAIL QTIS SAP: HC A02/MA01
Transition by Transmantics Inc., Washington, D.C.
Trans. into English from Air et Cosmus (France), no. 662, 12 Mar. 1977 p 19-22
MAUS: /AEROEPE ENGINEERING, ROTARY WINGS, TETHERING, V/STOL AIRCRAFT
INS: / HELICOPTER DESIGN, HELICOPTER PERFORMANCE, HOVERING, MILITARY AIRCRAFT, PRODUCT DEVELOPMENT

ABA: Author

ABS: Information on the recent study of the convertible plane is reported. The convertible plane was designed to replace the conventional helicopter. Its speed is much faster than that of the helicopter, it uses less fuel, and can carry up to five passengers. The discovery of the convertible plane was brought about because the helicopter is handicapped by its slow speed and can carry only a few passengers.

74N20757* ISSUE 12 PAGE 1385 CATEGORY 5
74/02/00 6 PAGES UNCLASSIFIED DOCUMENT

UTL: Technical evaluation of the Aerospace Medical Panel Specialists meeting on Escape Problems and Maneuvers in the Combat Aircraft
AUTH: A/JONES, W.L.

CORP: National Aeronautics and Space Administration, Washington, D.C.

In AGARD Escape Prool. and Maneuvers in Combat Aircraft 6 p (SEE N74-20756: 12-05)
MAUS: /AIRCRAFT EQUIPMENT, EJECTION SEATS, ESCAPE SYSTEMS, HELICOPTERS, SAFETY DEVICES, V/STOL AIRCRAFT
INS: / AERODYNAMIC FORCES, HUMAN FACTORS ENGINEERING, HUMAN TOLERANCES, LIFE SUPPORT SYSTEMS

ABA: Author

ABS: A technical evaluation of the papers presented at a conference on escape systems for helicopters and V/STOL aircraft was made. The subjects discussed include the following: (1) bioengineering aspects of spinal injury during ejection, (2) aerodynamic forces acting on crewman during escape, (3) operational practicality of fly away ejection seats, (4) helicopter survivability requirements, (5) ejection experience from V/STOL aircraft, and (6) research projects involving escape and retrieval systems.
provide vertical velocity commands. In the yaw channel
the manual controls provide sideslip or heading rate
commands at high or low airspeeds, respectively. The
control system permits pilots to fly along prescribed
flight paths in a precise manner with relatively low
work load.

7213686*# ISSUE 5 PAGE 566 CATEGORY 2 RPT#:
NASA-TG-F-13938 NAL-TR-113 71/12/00 23 PAGES
UNCLASSIFIED DOCUMENT
UTTL: Experimental study on the ground effect of a model
helicopter rotor in hovering
UNOC: Aerodynamic characteristics of model helicopter
hovering in ground effect flow
AUTH: A/KGO. J. B/OKA. T.
CORP: National Aeronautics and Space Administration,
Washington, D. C. AVAIL:NTIS
Transl. Into ENGLISH: Natl. Aerospace Lab., Tokyo,
report NAL-TR-113
MAJS: /*AERODYNAMIC CHARACTERISTICS/*GROUND EFFECT/*
HELICOPTERS/*HOVERING
MINS: / AERODYNAMIC DRAG/ DOWNWASH/ FLOW VISUALIZATION
ABA: Author
ABS: Aerodynamic characteristics of a model helicopter
rotor hovering in the ground effect have been
experimentally investigated. Measurements of the
thrust, torque and induced velocity of the hovering
rotor in the ground effect/and flow visualizations
around the hovering rotor in the ground effect by the
use of tuft. The qualitative results obtained are as
follows: (1) when a hovering rotor in higher pitch
angle gets near to the ground, there is a saturation
in the thrust increase from the ground effect
according to the blade stall, and (2) it appears from
flow observations that the periodical fluctuation of
interference flow between downwash and upwash may
introduce the unsteady phenomena of a hovering
helicopter in the ground effect.

70N34C28*# ISSUE 1B PAGE 3283 CATEGORY 2
70/07/00 8 PAGES UNCLASSIFIED DOCUMENT
UTTL: Helicopter testing in a wind tunnel
UNOC: Wind tunnel testing of helicopters, and test program
for Polish helicopter industry
AUTH: A/ERODZKI. Z.
CORP: National Aeronautics and Space Administration,
Washington, D. C. AVAIL:NTIS
TRANSL. INTO ENGLISH FROM BIUL. INFORM. INST.
LOTNICTWA, V. S. MAY-JUN. 1968 P 7-11
MAJS: /*AIRCRAFT INDUSTRY/*HELICOPTERS/*POLAND
MINS: / WIND TUNNEL APPARATUS/ WIND TUNNELS
POINT 27/2/1-389 TERMINAL-20
B32N74542* CATEGORY 5 RPT#: AO-A114307
D210-10689-2 REV-2 NASA-CR-168697 NAS 1.26:168697
D210-10689-2 REV- NAD-C-7265-60 CN#: NAS2-6107
N22967-79-C-0217 N22967-74-C-0757 79/10/00 852
PAGES UNCLASSIFIED DOCUMENT
Revised
UTL#: HESCOMP. The Helicopter Sizing and Performance
Computer Program. User’s manual. revision 2 TLSP:
AUTH: C/DAVIS, S. J.; R/ROSENSTEIN, H.; C/STANZIONE, K. A.;
J/WISENBEK, J. S.
CORP: Boeing Vertol Co., Philadelphia, PA. AVAIL.NTIS
MAJ$: /AIRCRAFT DESIGN/AIRPLANE PROGRAMS/AIRPLANE
DESIGN/HELICOPTER PERFORMANCE/HELICOPTERS/SHAPE
DIMENSIONS/USER MANUALS (COMPUTER PROGRAMS)
MINS: /AERODYNAMIC CONFIGURATIONS/ AIRCRAFT SPECIFICATIONS/
FUEL CONSUMPTION/ HELICOPTER ENGINES/ ROTARY WINGS

B32N2152* CATEGORY 2 RPT#: NASA-CR-3503 CN#: PROJ.
FEDD NCC-292 62/01/00 129 PAGES
UNCLASSIFIED DOCUMENT DOMESTIC
UTL#: The investigation of a variable camber blade lift
control for helicopter rotor systems TLSP: An Early
Domestic Dissemination Report
AUTH: A/MASS, A. O.
SAP: Available NASA Industrial Applications Centers only
MAJ$: /CONTROLS/HELICOPTER CONTROL/HEADING
ROTARY WINGS/HELICOPTER PERFORM./HELICOPTERS/
WING CAMBER
MINS: /AIRFOIL PROFILES/ DYNAMIC CHARACTERISTICS

B32N7177* CATEGORY 2 RPT#: NASA-CR-165848
PPI-1002-2 CN#: NAS1-15561 81/12/00 112 PAGES
UNCLASSIFIED DOCUMENT
UTL#: Implementation of refinements in a dynamic analysis of
periodic systems TLSP: Final Report
AUTH: A/MASS, A. E.
MAJ$: /AIRCRAFT DESIGN/HELICOPTERS/HELICOPTER PERFORM.
SYSTEMS ANALYSIS/HELICOPTER PERFORM.
MINS: /ACTIVE CONTROL/AERODYNAMICS/HELICOPTERS/HELICOPTERS

B32N7703* CATEGORY 66 RPT#: NASA-CR-164740
JPL-SYA-650-89-VOL-2 70/09/08 2 VOLS 96 PAGES
UNCLASSIFIED DOCUMENT
UTL#: Effectiveness analysis of helicopter patrols. Volume
2: Evaluation
CORP: Jet Propulsion Lab., California Inst. of Tech.,
Pasadena. AVAIL.NTIS
MAJ$: /HELICOPTERS/POLICE/HELICOPTERS/HELICOPTERS/POLICE
MINS: /HELICOPTERS/HELICOPTERS/HELICOPTERS/HELICOPTERS

B32N7702* CATEGORY 66 RPT#: NASA-CR-164739
JPL-SYA-650-89-VOL-1 70/07/27 2 VOLS 37 PAGES
UNCLASSIFIED DOCUMENT
UTL#: Effectiveness analysis of helicopter patrols. Volume
1: Summary
CORP: Jet Propulsion Lab., California Inst. of Tech.,
Pasadena. AVAIL.NTIS
MAJ$: /HELICOPTERS/POLICE/HELICOPTERS/HELICOPTERS/POLICE
MINS: /HELICOPTERS/HELICOPTERS/HELICOPTERS/HELICOPTERS

B32N7584* CATEGORY 5 RPT#: NASA-CR-166219
REP-699-090-003 CN#: NAS2-8862 75/09/17 405
PAGES UNCLASSIFIED DOCUMENT
UTL#: Planning study for implementation of Tilt Rotor
Technologies for Operational Aircraft TLSP: Final
Report
CORP: Textron Bell Helicopter. Fort Worth, Tex.
Sponsored by: Army
MAJ$: /PROJECT PLANNING/TILT ROTOR RESEARCH AIRCRAFT
MINS: /COMPOSITE STRUCTURES/ ENGINE DESIGN/ TILT ROTOR
AIRCRAFT/ WEIGHT REDUCTION

B32N7433* CATEGORY 5 RPT#: NASA-CR-164241
LIDS-9-1067 CN#: NGL-22-090-124 81/04/00 24
PAGES UNCLASSIFIED DOCUMENT
UTL#: Report on trip to NASA Ames Research Center Flight
Dynamics and Controls Branch. 19-23 Jan. 1980
AUTH: A/MICHELSTROM, G. C.
CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Lab.
for Information and Decision Systems.) AVAIL.NTIS
MAJ$: /HELICOPTERS/AIRCRAFT CARRIERS/AIRCRAFT
MINS: /HELICOPTERS/AIRCRAFT CARRIERS/AIRCRAFT

TERMINAL 20 PAGE 1 (ITEMS 1-7 OF 389)
of the isolated rotor show a great deal of scatter reflecting the fact that the rotor in hover is basically unstable.

B82-32292* ISSUE 14 PAGE 1901 CATEGORY 3
82/04/06 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: A pilot in the loop analysis of helicopter acceleration/deceleration maneuvers

AUTH: A/HEFFLEY, A. K.

AVAIL.NTIS S/N: HC A11/MF A01

In NASA, Ames Research Center. Helicopter Handling Qualities, p 221-232 (See NB2-23208 14-03)

MAJS: /ACCELERATION (PHYSICS)/FLIGHT SIMULATION/FLIGHT TRAINING/HELICOPTER PERFORMANCE

MINS: / AIRCRAFT MANEUVERS/ HOVERING STABILITY/

NAP-OF-THE-EARTH NAVIGATION/ PILOT PERFORMANCE

ABA: Author

ABS: Helicopter flight acceleration, deceleration maneuvers are quantified and put to use in the fields of handling qualities, flight training and evaluation of simulator fidelity. The three specific cases include the normal speed change maneuver, the nap-of-the-earth dash, and the decelerating approach to hover. All of these maneuvers share common generic features in terms of pilot adaptation and mathematical description: yet each differs in terms of the essential feedback loop structure. Implications for handling qualities requirements, and simulator fidelity criteria.

B82-24050* ISSUE 14 PAGE 2018 CATEGORY 71
RPT#: NASA-CR-166337 NAS-1: 26.166337 CNT#: NAS2-10767
82/04/00 100 PAGES UNCLASSIFIED DOCUMENT

UTTL: An investigation of rotor harmonic noise by the use of small scale wind tunnel models. Final Report

AUTH: A/STERNFELD, H., JR.; B/SCHAFER, E. G.


AVAIL.NTIS S/N: HC A05/MF A01

MAJS: /AIRCRAFT NOISE/HARMONICS/NOISE MEASUREMENT/ROTARY WINGS

MINS: / ACOUSTICS/ SCALE MODELS/ WIND TUNNEL TESTS

ABA: Author

ABS: Noise measurements of small scale helicopter rotor models were compared with noise measurements of full scale helicopters to determine what information about the full scale helicopters could be derived from noise measurements of small scale helicopter models. Comparisons were made of the discrete frequency (incidental) noise for 4 pairs of tests. Areas covered were tip speed effects, isolated rotor, tandem rotor, and main rotor/tail rotor interaction. Results show good comparison of noise trends with configuration and test condition changes. and good comparison of absolute noise measurements with the corrections used except for the isolated rotor case. Noise measurements

B82-23208* ISSUE 14 PAGE 1501 CATEGORY 3
82/04/06 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: Past applications and future potential of variable stability research helicopters

AUTH: A/HINDSON, W. S.

CORP: Stanford Univ., Calif. CNT: (Joint Inst. of Aeronautics and Acoustics.) AVAIL.NTIS S/N: HC A11/MF A01

In NASA, Ames Research Center. Helicopter Handling Qualities, p 209-219 (See NB2-23208 14-03)

MAJS: /HELICOPTER DESIGN/ ROTARY WING AIRCRAFT/ VARIABLE PITCH PROPELLERS

MINS: / HELICOPTER PERFORMANCE/ HISTORIES/ TECHNOLOGICAL FORECASTING

ABA: Author

ABS: The historical development of variable-stability research helicopters and some of their previous applications are presented as a guide for assessing their future potential. The features of three general-purpose rotary-wing flight research aircraft that provide complementary capabilities are described
A number of future applications are proposed.

B2N23226* ISSUE 14 PAGE 1900 CATEGORY 3
02/04/09 6 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/HOM, R. H.
AVAIL: NTIS SAP: HC A11/MF ADI
In NASA Ames Research Center Helicopter Handling Qualities p 193-198 (SEE N82-22320 14-03)

Majs: / FIXED WINGS/ HELICOPTER PERFORMANCE/ ROTARY WING AIRCRAFT

MINS: / HANDBOOKS/ HELICOPTER DESIGN/ STANDARDS

ABA: Author

ABS: Some recent considerations and developments in handling quality criteria are reviewed with emphasis on using fixed wing experience gained in developing MIL-F-8785C and the more recent MIL Standard and Handbook. Particular emphasis is placed on the tasks and environmental conditions used to develop the criterion boundaries, SAS failures, and potential fixed wing criteria that are applicable to rotary wing aircraft.

B2N23225* ISSUE 14 PAGE 1900 CATEGORY 3
02/04/00 10 PAGES UNCLASSIFIED DOCUMENT

In NASA Ames Research Center Helicopter Handling Qualities p 183-192 (SEE N82-22320 14-03)

Majs: / AVIONICS/ CATHODE RAY TUBES/ COCKPITS/ DISPLAY DEVICES/ HELICOPTER DESIGN

MINS: / DESIGN ANALYSIS/ HELICOPTER CONTROL/ INFORMATION RETRIEVAL/ STANDARDS/ SYSTEMS ENGINEERING

ABA: Author

ABS: Weight, size, and mission requirements for the A-129 mandated an integrated system design approach for the crew/cockpit interface design for the cantilever control. Integration of the usual multitude of cockpit controls, indicators, gauges, and lights, the primary crew interface is a single multifunction keyboard and one or more multifunction CRT display units. This cockpit design approach imposed unusual constraints upon the system architecture to overcome the inherent information access limitations of a data input/output window that was restricted by the available space. The conceptual approach and resulting design of the A-129 cockpit with the intent to enhance the development of cockpit standardization are described.

B2N23224* ISSUE 14 PAGE 1900 CATEGORY 3
02/04/00 11 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/GREEN, D. L.
In NASA Ames Research Center Helicopter Handling Qualities p 171-181 (SEE N82-22320 14-03)

Majs: / AIRCRAFT CONTROL/ COCKPITS/ DISPLAY DEVICES/ HELICOPTER DESIGN/ MILITARY HELICOPTERS

MINS: / AIRCRAFT INSTRUMENTS/ ALTIMETERS/ CONTROL/ DIRECTIONAL CONTROL/ FLIGHT CONTROL/ HUMAN FACTORS ENGINEERING/ YAW

ABA: M.D.K.

ABS: Extensive experience in both operational and engineering test flight was used to suggest straightforward changes to helicopter cockpit and control system design that would improve pilot performance in marginal and instrument flight conditions. Needed control system improvements considered include: (1) separation of yaw from cyclic force trim, (2) pedal force proportional to displacement rate, and (3) integration of engine controls in the collective stick. Display improvements needed include: (1) natural curing of yaw rate in attitude indicator; (2) collective position indication and rudder altimeter placed within primary scan; and (3) a directional display of full range airspeed data.
ABS: In the design of a VH-65A helicopter cockpit, advanced integrated electronics systems technology was employed to achieve several important goals for this multimission aircraft. They were: (1) integrated systems operation with consistent and simplified cockpit procedures; (2) mission-task-related cockpit displays and controls; and (3) reduced pilot instrument scan effort with excellent outside visibility. The integrated avionics system was implemented to depend heavily upon distributed but complementary processing, multiplex digital bus technology, and multifunction CRT controls and displays. This avionics system was completely flight tested and will soon enter operational service with the Coast Guard.

B2N23242# ISSUE 14 PAGE 1899 CATEGORY 3 82/04/00 22 PAGES UNCLASSIFIED DOCUMENT

UTTI: An assessment of various side-stick controller/stability and control augmentation systems for night nap-of-Earth flight using piloted simulation

AUTH: A. LANDIS, K. H.; B. AIKEN, E. W.; PAA; B/Army Research and Technology Labs., Moffs Field, Calif.)

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL. NTS SAP: HC A11/OF AD1 In NASA, Ames Research Center Helicopter Handling Qualities p 75-96 (See H02-23200 14-03)


ABA: T. M.

ABS: Several night nap-of-the-earth mission tasks were evaluated using a helmet-mounted display which provided a limited field-of-view image with superimposed flight control symbology. A wide range of stability and control augmentation designs was investigated. Variations in control force deflection characteristics and the number of axes controlled through an integrated side-stick controller were studied. In general, a small displacement controller is preferred over a stiff stick controller for night nap-of-the-earth flight. Higher levels of stability augmentation were required for IIM tasks to provide handling qualities comparable to those achieved for the same tasks conducted under simulated visual flight conditions.

B2N232313# ISSUE 14 PAGE 1899 CATEGORY 3 82/04/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTI: Flight tests for the assessment of task performance and control activity

AUTH: A. PAUSDORF, H. J.; H. HUGGES, D.

CORP: Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (est Germany). CSS: Inst. fuer Flugmechanik. AVAIL. NTS SAP: HC A11/OF AD1 In NASA, Ames Research Center Helicopter Handling Qualities p 35-46 (See N82-22200 14-03)


MINS: / ATTITUDE CONTROL/ CONTROLLABILITY/ DATA ACQUISITION/ HELICOPTER PERFORMANCE/ HOVERING/ MILITARY OPERATIONS

ABA: T. M.

ABS: The tests were performed with the helicopters BO 105 and UH-1D. Closely connected with tactical demands the six test pilots’ task was to minimize the time and the altitude over the obstacles. The data reduction yields statistical evaluation parameters describing the control activity of the pilots and the achieved task performance. The results are shown in form of evaluation diagrams. Additionally, dolphin tests with
varied control strategy were performed to get more insight into the influence of control techniques. From these test results recommendations can be derived to emphasize the direct force control and to reduce the collective to pitch crosscoupling for the dolphin.

B2N3212# ISSUE 14 PAGE 1099 CATEGORY 3
B2/04/00 11 PAGES UNCLASSIFIED DOCUMENT
UTTL: Influence of maneuverability on helicopter combat effectiveness
AUTH: A/FALCO, M.; B/SMITH, R. PAA: B/Army Aviation Research and Development Command, St. Louis, Mo.
CORP: Grumman Aerospace Corp., Bethpage, N.Y. AVAIL:NTIS
SAP: HC 111/WE 001
In NASA, Ames Research Center Helicopter Handling Qualities p 23-33 (SEE N82-22008 14-03)
MAJS: /COMBAT/EFFECTIVENESS/HELICOPTER PERFORMANCE/
MANEUVERABILITY/MILITARY HELICOPTERS
MINS: / AIRCRAFT RELIABILITY/CONTROLABILITY/FEEDBACK CONTROL/HELICOPTER CONTROL/WEAPON SYSTEMS
ABA: T.M.
ABS: A computational procedure employing a stochastic searching method in conjunction with dynamic simulation of helicopter flight and weapon system operation was used to derive maneuvering strategies. The derived strategies maximize either survival or kill probability and are in a feedback control based upon threat visual or warning system cues. Maneuverability parameters implicit in the strategy development include maximum longitudinal acceleration and acceleration, maximum sustained and transient load factor turn rate at forward speed and maximum pedal turn rate and lateral acceleration at hover. Results are presented in terms of probability of kill for all combat initial conditions for two threat categories.

B2N3211# ISSUE 14 PAGE 1098 CATEGORY 3
B2/04/00 8 PAGES UNCLASSIFIED DOCUMENT
UTTL: Boeing 234 flight control development
AUTH: A/MORRIS, J. J.
SAP: HC 111/WE 001
In NASA, Ames Research Center Helicopter Handling Qualities p 15-22 (SEE N82-22008 14-03)
MAJS: / ATTITUDE CONTROL/AUTOMATIC FLIGHT CONTROL/BOEING AIRCRAFT/HELICOPTER CONTROLLER
MINS: / AIRCRAFT INSTRUMENTS/CERTIFICATION/CH-47 HELICOPTER/ MANEUVERABILITY/NAVIGATION AIDS/RADAR NAVIGATION
ABA: Author
ABS: The Boeing 234 is the commercially certified derivative of the CH-47 Chinook. The automatic flight control system and flight director with coupler were designed to reduce pilot workload for missions of approximately six hour duration using VFR IFR, day and night conditions. The AFCS system for the 234 is essentially the same system as developed for the CH-47D, which has airspeed hold, altitude hold, and maneuver enhancement in all three axes. The system also has the capability to connect to the Sperry heli-cs flight director system which includes for enroute navigation and landing enhancements. Certification testing was completed by both the FAA and CAA, to FAR Part 29 for Transport Category Rotorcraft and BCA Section G: Rotorcraft. The aircraft was certified for civil operation in June 1981.

B2N3220# ISSUE 14 PAGE 1098 CATEGORY 3
B2/04/00 7 PAGES UNCLASSIFIED DOCUMENT
UTTL: V TOL and VSTOL handling qualities specifications, an overview of the current status
CORP: Aeronautic Helicopter Corp., Grand Prairie, Tex. AVAIL:NTIS SAP: HC 111/WE 001
In NASA, Ames Research Center Helicopter Handling Qualities p 9-13 (SEE N82-22008 14-03)
MAJS: / AIRCRAFT RELIABILITY/AVIONICS/CERTIFICATION/CIVIL AVIATION/FLIGHT TESTS/MILITARY HELICOPTERS
MINS: / AUTOMATIC FLIGHT CONTROL/EVALUATION/HELICOPTER CONTROL/PERFORMANCE TESTS/QUALITY CONTROL
ABA: T.M.
ABS: Certification programs with particular emphasis on handling qualities requirements are described. A dynamic simulator was designed and constructed to support and verify the dynamic aspects of the avionics system, particularly the Automatic Flight Control System (AFCS). The role of the Dynamic Simulator is discussed.
The highlights of a comparative analysis between the current helicopter and VSTOL specifications and four representative rotary wing aircraft configurations were presented. The longitudinal, lateral, and directional control power and dynamic stability characteristics were analyzed for hovering conditions. Forward flight static and dynamic stability were analyzed for the longitudinal and lateral-directional axes. Results of the analyses in terms of the applicability of the MIL-H-8501A criteria are presented for each of the above areas. The reevaluation of the MIL-H-8501A criteria against those in MIL-B-23005 and AGARD 577 indicate many areas in which MIL-H-8501A does not give adequate design guidance.

B2N22150# ISSUE 13 PAGE 1758 CATEGORY 5 RPT#: NASA-CR-166313 NAS 1.26:166313 STI-TR-1156-1 CNT#: NAS2-10400 30/05/00 91 PAGES UNCLASSIFIED DOCUMENT

A theory of human error TLP: Final Report
CORP: Systems Technology Inc., Hawthorne, Calif.
AVAIL. NTIS: SAP: HC A03/MF A01
MAJS: /AIRCRAFT/ACCIDENTS/ERROR ANALYSIS/HUMAN FACTORS ENGINEERING/OPERATIONS (PERSONNEL)/PILOT ERROR
MINS: / AIR NAVIGATION/AIR TRAFFIC CONTROL/ AIRCRAFT SAFETY
/ DECISION MAKING/FLIGHT SIMULATION/ MAN MACHINE SYSTEMS/ MANUAL CONTROL

B2N22249# ISSUE 13 PAGE 1758 CATEGORY 5 RPT#: NASA-CR-166314 NAS 1.26:166314 STI-TR-1156-2 CNT#: NAS2-10400 80/05/00 140 PAGES UNCLASSIFIED DOCUMENT

ULT: Technical Approaches for measurement of human errors TLP: Final Report
CORP: Systems Technology Inc., Hawthorne, Calif.
AVAIL. NTIS: SAP: HC A07/MF A01
MAJS: /AIRCRAFT/ACCIDENTS/ERROR ANALYSIS/HUMAN FACTORS ENGINEERING/MAN MACHINE SYSTEMS/PILOT PERFORMANCE
MINS: / AIRCRAFT SAFETY/FLIGHT SIMULATION/HUMAN REACTIONS/PSYCHOMOTOR PERFORMANCE

B2N22250# ISSUE 13 PAGE 1758 CATEGORY 5 RPT#: NASA-CR-166314 NAS 1.26:166314 STI-TR-1156-2 CNT#: NAS2-10400 30/05/00 91 PAGES UNCLASSIFIED DOCUMENT

A theory of human error TLP: Final Report
AUTH: B/MEIER, D. T.; B/CLEKENI, W. F.; C/ALLEN, R. W.
CORP: Systems Technology Inc., Hawthorne, Calif.
AVAIL. NTIS: SAP: HC A03/MF A01
MAJS: /AIRCRAFT/ACCIDENTS/HUMAN BEHAVIOR/HUMAN FACTORS ENGINEERING/OPERATIONS (PERSONNEL)/PILOT ERROR
MINS: / AIR NAVIGATION/AIR TRAFFIC CONTROL/ AIRCRAFT SAFETY
/ DECISION MAKING/FLIGHT SIMULATION/ MAN MACHINE SYSTEMS/ MANUAL CONTROL

Human error is a significant contributing factor in a very high proportion of civil transport, general aviation, and rotorcraft accidents. The technical details of a variety of proven approaches for the measurement of human errors in the context of the national airspace system are presented. Unobtrusive measurements suitable for cockpit operations and procedures in part of full mission simulation are emphasized. Procedures, system performance, and human operator centered measurements are discussed as they apply to the manual control, communication, supervision, and monitoring tasks which are relevant to aviation operations.

B2N22264# ISSUE 13 PAGE 1757 CATEGORY 5 RPT#: NASA-CR-166322 NAS 1.26:166322 STI-TR-1156-3 CNT#: NAS2-10276 80/08/00 33 PAGES UNCLASSIFIED DOCUMENT

ULT: Conceptual design study of a visual system for a rotorcraft simulator and some advances in platform motion utilization TLP: Final Report
AUTH: A/SINACORI, J. B.
AVAIL. NTIS: SAP: HC A03/MF A01
MAJS: /AIRCRAFT DESIGN/FLIGHT SIMULATORS/HELICOPTERS/
TECHNOLOGY ASSESSMENT/VISUAL CONTROL
MINS: / FEASIBILITY ANALYSIS/FLIGHT SAFETY/ROTOR WING AIRCRAFT/ TRAINING DEVICES/ TRAINING SIMULATORS

A theory of human error TLP: Final Report
AUTH: A/SINACORI, J. B.
AVAIL. NTIS: SAP: HC A03/MF A01
MAJS: /AIRCRAFT DESIGN/FLIGHT SIMULATORS/HELICOPTERS/
TECHNOLOGY ASSESSMENT/VISUAL CONTROL
MINS: / FEASIBILITY ANALYSIS/FLIGHT SAFETY/ROTOR WING AIRCRAFT/ TRAINING DEVICES/ TRAINING SIMULATORS

A theory of human error TLP: Final Report
AUTH: A/SINACORI, J. B.
AVAIL. NTIS: SAP: HC A03/MF A01
MAJS: /AIRCRAFT DESIGN/FLIGHT SIMULATORS/HELICOPTERS/
TECHNOLOGY ASSESSMENT/VISUAL CONTROL
MINS: / FEASIBILITY ANALYSIS/FLIGHT SAFETY/ROTOR WING AIRCRAFT/ TRAINING DEVICES/ TRAINING SIMULATORS

terminal 20 page 7 (items 32-34 of 369)
AEREOELASTICITY/*BEARINGS/*GIMBALS/*HELICOPTER DESIGN/*HELICOPTERS/*HUGS/*ROTARY WINGS

COMPUTER PROGRAMS/*COURIOLIS EFFECT/*EQUATIONS OF MOTION/*FLEXIBILITY/*FLIGHT CHARACTERISTICS/*LOADS (FORCES)/SHAFTS (MACHINE ELEMENTS)/STIFFNESS

An aerelastic and structural loads analysis of the elastic gimbal rotor (EGR) was conducted. The structural loads analysis of the elastic gimbal rotor indicated that the gimbal spring element is the critical component in the rotor system design, but that practical designs for all components should be achievable. The aerelastic analysis was conducted using a version of the G400 Rotor Aerelastic Analysis specially modified to evaluate the EGR. Hydrostability showed that a stiff inplane blade was more stable than a soft inplane blade. Stability was sensitive to control system coupling (pitch gimbal coupling), gimbal spring stiffness, and blade frequency placement. Ground resonance analysis showed both soft and stiff inplane rotors to be stable. A limited evaluation of the EGR in forward flight was conducted. Due to G400 analysis limitations, the results were not sufficient to define forward flight stability and stress limits.
MIN: AERODYNAMIC LOADS/Degrees of Freedom/ Eigenvaleues/Equations of Motion/Equilibrium Equations/Galerkin Method/RIGID ROTORS

ABA: A.R.H.

ABS: A finite element method for the spatial discretization of the dynamic equations of equilibrium governing rotary-wing aerelastic problems is presented. Formulation of the finite element equations is based on weighted Galerkin residuals. This Galerkin finite element method reduces algebraic manipulative labor significantly, when compared to the application of the global Galerkin method in similar problems. The coupled flap-lag aerelastic stability boundaries of hingeless helicopter rotor blades in hover are calculated. The linearized dynamic equations are reduced to the standard eigenvalue problem from which the aerelastic stability boundaries are obtained. The convergence properties of the Galerkin finite element method are studied numerically by refining the discretization process. Results indicate that four or five elements suffice to capture the dynamics of the blade with the same accuracy as the global Galerkin method.


UTTLE: Correlating measured and predicted in-plane stability characteristics for an advanced bearingless rotor TLSP: Final Report

AUTH: A/NELLER, W. H.

CORP: Textron Bell Helicopter, Fort Worth, Tex.

AVA1.NRIS SAP: HC A04/MA A01

MAJS: AERODYNAMIC STABILITY/AERELASTICITY/BEARINGLESS ROTORS/ROTARY STABILITY

MINS: DYNAMIC TESTS/GROUND EFFECT (AERODYNAMICS)/HELICOPTER PERFORMANCE/HOVERING

ABA: T.M.

ABS: The experimental data were obtained from hover tests of a model H-rotor for the testing of a model of an advanced bearingless main rotor. Both isolated rotor and ground resonance conditions were tested. Test parameters included blade built-in cone, flap and sweep angles, rotor inplane structural damping, pitch link location and fuselage structural damping. Analytical results for the conditions tested were obtained using current Bell Helicopter analyses. In addition, variations in the analytical models were made to assess their impact on the correlation between computed and measured results. Results are presented in tabular and graphical form.

B2N17152* ISSUE 8 PAGE 1027 CATEGORY 5 RPT#: NASA-CR-166246 GER-17016 CNT#: NASA-10777 B1/07/00 286 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Preliminary design study of a hybrid airship for flight research

AUTH: A/BRK, Test R. G. E.

CORP: Goodyear Aerospace Corp., Akron, Ohio. AVAIL.NRIS SAP: HC A13, MF A01

MAJS: AERODYNAMIC CONFIGURATIONS/AIRCRAFT DESIGN/AIRSHIPS/RESEARCH AIRCRAFT/ROTORCRAFT AIRCRAFT

MINS: CONTROL STABILITY/COST ESTIMATES/FEASIBILITY ANALYSIS/FLIGHT CHARACTERISTICS/HYBRID STRUCTURES/STRUCTURAL DESIGN/STRUCTURAL WEIGHT/WIND TUNNEL TESTS

ABA: Author

ABS: The feasibility of using components from four small
helicopters and an airship envelope as the basis for a quad-rotor research aircraft was studied. Preliminary investigations included a review of candidate hardware and various combinations of rotor craft and configurations. A selected vehicle was analyzed to assess its structural and performance characteristics.

B2N16043# ISSUE 7 PAGE 863 CATEGORY 1 RPT:
NASA-CR-166153 CNT#: NASA-16089 81/01/00 312 PAGES UNCLASSIFIED DOCUMENT

UTL: Pre-design study for a modern four-bladed rotor for the rotor system research aircraft (RSRA) -- final report integrating the YAH-64 main rotor. TSP: Final Report
AUTH: D/KEYS, C. N.; E/SMITH, K. E.; F/SMITH, J. H.; G/STAELE, J. A.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NIIS
SAP: HC A03/MF A01
MAJS: /AERODYNAMIC LOADS/ AERODYNAMIC COEFFICIENTS/ AERODYNAMIC LOADS/ ECONOMIC FACTORS/ FLIGHT TESTS/ GROUND TESTS/ STRUCTURAL ANALYSIS
MIN: /AERODYNAMICS/ HELICOPTER DESIGN/ ROTARY WINGS/ STRUCTURAL DESIGN CRITERIA/ TRADEOFFS

B2N16042# ISSUE 7 PAGE 863 CATEGORY 1 RPT:
NASA-CR-166153 CNT#: NASA-16089 81/01/00 312 PAGES UNCLASSIFIED DOCUMENT

UTL: Predesign study for a modern 4-bladed rotor for the NASA rotor systems research aircraft
AUTH: D/KEYS, C. N.; E/SMITH, K. E.; F/SMITH, J. H.; G/STAELE, J. A.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NIIS
SAP: HC A03/MF A01
MAJS: /AERODYNAMIC LOADS/ AERODYNAMIC COEFFICIENTS/ AERODYNAMIC LOADS/ ECONOMIC FACTORS/ FLIGHT TESTS/ GROUND TESTS/ STRUCTURAL ANALYSIS
MIN: /AERODYNAMICS/ HELICOPTER DESIGN/ ROTARY WINGS/ STRUCTURAL DESIGN CRITERIA/ TRADEOFFS

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at lower tip speed provided the best performance and lowest noise. The tapered planform had lowered performance figures due to the reduced solidity. However, some noise reductions were achieved.
studies and the recommended plan for development and qualification of the rotor system is also given. Its parameter variants, integration on the RSGA, and support of ground and flight test programs are also discussed.

**B2N16008** ISSUE 6 PAGE 857 CATEGORY 85 RPT#:
NASA-CR-166266 CNT#: NASA2-10798 81/12/00 181 PAGES UNCLASSIFIED DOCUMENT


**AUTH:** A/GILBERT, G. A.; B/FREID, D. J.; C/CINNANI, R. M.; D/CAFARRELLI, N. J.; E/HODGINS, R. F.; F/VICKERS, T. K.

**CORP:** Helicopter Association of America. Washington, D. C.

**AVAIL:** NTIS SAP: HC AO9/MF A01

**MNS:** AIR TRANSPORTATION/COMMUNITIES/HELICOPTERS/TECHNOLOGY ASSESSMENT

**ANS:** HELICOPTERS/LANDING/ROTOR VEHICLES/PLANNING/RAIL TRANSPORTATION/REGULATIONS/SITE SELECTION/TRANSPORTATION NETWORKS/URBAN TRANSPORTATION/VERTICAL TAKEOFF

**ABA:** R.F.

**ABS:** Information about rotorcraft that will assist community planners in assessing and planning for the usefulness of rotorcraft in the communities is provided. Information useful to helicopter researchers, manufacturers, and operators concerning helicopter opportunities and benefits is also given. Three primary topics are discussed: the current status and future projections of rotorcraft technology, and the comparison of that technology with other transportation vehicles; the community benefits of using rotorcraft transportation opportunities; and the integration and interfacing considerations between XV-15 and other transportation vehicles. Helicopter applications in a number of business and public service fields are examined in various geographical settings.

**B2N15013** ISSUE 6 PAGE 717 CATEGORY 2 RPT#:
NASA-CR-155078 CNT#: NASA2-38 81/12/00 6 PAGES UNCLASSIFIED DOCUMENT


**AUTH:** A/CRESPODASILVA, M. R. M.

**CORP:** Cincinnati Univ., Ohio. CS: (Dept. of Aerospace Engineering and Applied Mechanics.) NTIS AVAIL SAP: HC AO2/MF A01

**MNS:** EQUATIONS OF MOTION/HELICOPTERS/-hovering STABILITY OF ROTOR AIRCRAFT/ embraced ROSS/TORSIONAL STABILITY

**ANS:** AERODYNAMICS/ ANALYSIS (MATHEMATICS)/DYNAMIC STABILITY/ROTOR BLADES (TURBOMACHINERY)

**ABA:** L.F.M.

**ABS:** The differential equations describing the flap-lag-torsional motion of a flexible rotor blade including third-order nonlinearities were derived for hover and forward flight. Making use of the two boundary conditions, those equations were reduced to a set of three integro partial differential equations written in terms of the flexural deflections and the torsional variable.

**B2N12092** ISSUE 3 PAGE 255 CATEGORY 9 RPT#:
NASA-CR-166252 CNT#: NASA2-10741 81/09/23 67 PAGES UNCLASSIFIED DOCUMENT

**UTL:** Simulator certification methods and the vertical motion simulator TLSP: Final Report

**AUTH:** A/SHOWALTER, T. W.

**CORP:** Computer Sciences Corp., Mountain View, Calif. NTIS AVAIL SAP: HC AD4/MF A01

**MNS:** CERTIFICATION/PERFORMANCE PREDICTION/PILOT TRAINING/VERTICAL MOTION SIMULATORS

**ANS:** CDC 7600 COMPUTER/DEVELOPMENT/ EQUIPMENT SPECIFICATIONS/FLIGHT SIMULATORS/HELICOPTERS/SHORT TAKEOFF/ AIRCRAFT/USER REQUIREMENTS/VERTICAL TAKE-OFF AIRCRAFT
ABA: S. L.
ABS: The vertical motion simulator (VMS) is designed to simulate a variety of experimental helicopter and STOL/VTOL aircraft as well as other kinds of aircraft with special pitch and 2-axis characteristics. The VMS includes a large motion base with extensive vertical and lateral travel capabilities, a computer generated image visual system, and a high speed CDC 7600 computer system, which performs aero model calculations. Guidelines on how to measure and evaluate VMS performance were developed. A survey of simulation users was conducted to ascertain if they evaluated and certified simulators for use. The results are presented.

8ZN11071*# ISSUE 2 PAGE 150 CATEGORY B RPT#: FDRL-B1-7 NASA-CR-166297 CNT#: NSG-2142 01/10/00 124 PAGES UNCLASSIFIED DOCUMENT
ULTL: Aeroacoustic theory for noncompact wing-gust interaction
AUTH: A/MARTINEZ, R. J.; B/WIDNALL, S. E.
CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Dept. of Aeronautics and Astronautics.) AVAIL. NTIS SAP: HC A04/MF A01
MAJS: /AERODYNAMICS/*AERODYNAMIC CONFIGURATIONS/*AIRCRAFT NOISE/AIRFOIL PROFILES/*EDGING/LOADING/*GUST LOADS/*MATHEMATICAL MODELS/*ROTARY WINGS/*SUBSONIC FLOW/*THREE DIMENSIONAL FLOW/WING LOADING
MINS: /ACOUSTIC PROPERTIES/BLADE SLAP NOISE/BOUNDARY VALUE PROBLEMS/DIRECTIVITY/INFINITE SPAN WINGS/LEADING EDGES/ROTARY WINGS/SUBSONIC SPEED/VORTICES
ABA: RF
ABS: Three aerodynamic models for noncompact wing-gust interaction were developed for subsonic flow. The first is that for a two-dimensional (finite span) wing passing through an oblique gust. The unsteady acoustic field was obtained by the Wiener-Hopf technique: the airfoil loading and the associated acoustic field were calculated, respectively, by allowing the field point on the airfoil surface, or by letting it go to infinity. The second model is a simple spanwise superposition of two dimensional solutions to account for three dimensional acoustic effects on wing rotation (for a helicopter blade, or some other rotating platform) and of finiteness of wing span. A three dimensional theory for a single gust was applied to calculate the acoustic signature in closed form due to blade vortex interaction in helicopters. The third model is that of a quarter infinite plate with side edge through a gust at high subsonic speed. An approximate solution for the three dimensional loading and the associated three dimensional acoustic field in closed form was obtained. The results reflected the acoustic effect of satisfying the correct loading condition at the side edge.

8GN1059*# ISSUE 2 PAGE 260 CATEGORY 71 RPT#: NASA-CR-3470 CNT#: N651-15730 01/11/00 150 PAGES UNCLASSIFIED DOCUMENT
ULTL: Helicopter rotor trailing edge noise analysis - noise prediction
TLSP: Final Report
AUTH: A/SCHLINDER, R. H.; B/AMIER, R. K.
CORP: United Technologies Research Center, East Hartford, Conn. AVAIL. NTIS SAP: HC A07/MF A01
MAJS: /*AIRCRAFT NOISE/*HELMETORS/*NOISE PREDICTION (AIRCRAFT)/ROTARY WINGS/*TRAILING EDGES/*WIND TUNNEL TESTS
MINS: /*AERODYNAMIC NOISE/BOUNDARY LAYERS/BROADBAND/ DATA ACQUISITION/*NOISE GENERATORS/*SCALING LAWS
ABA: A.R.H.
ABS: A two dimensional section of a helicopter main rotor blade was tested in an acoustic wind tunnel at close to full-scale Reynolds numbers to obtain boundary layer data and acoustic data for use in developing an acoustic scaling law and testing a first principles trailing edge noise theory. Results were extended to the rotating frame coordinate system to develop a helicopter rotor trailing edge noise prediction. Comparisons of the calculated noise levels with helicopter flyover spectra demonstrate that trailing edge noise contributes significantly to the total helicopter noise spectrum at high frequencies. This noise mechanism is expected to control the minimum rotor noise. In the case of noise radiation from a local blade segment, the acoustic directivity pattern is predicted by the first principles trailing edge noise theory. Acoustic spectra are predicted by a scaling law which includes Mach number, boundary layer thickness, and observer position. Spectrum shape and sound pressure level are also predicted by the first principles theory but the analysis does not predict the Strickland value identifying the spectrum peak.

BIN32154*# ISSUE 23 PAGE 3151 CATEGORY 9 RPT#: NASA-CR-164029 CNT#: NGR-11-002-185 76/00/00 67 PAGES UNCLASSIFIED DOCUMENT
ULTL: Two-dimensional dynamic stall as simulated in a varying freestream
AUTH: A/PIERCE, G. A.; B/MUNZ, D. L.; C/MALONE, J. B.
CORP: Georgia Inst. of Tech., Atlanta. CSS: (School of Aerospace Engineering.) AVAIL. NTIS SAP: HC A04/MF A01
MAJS: /*AERODYNAMIC STALLING/*FREE FLOW/*HELMETORS/*ROTARY WINGS/*ROTOR AERODYNAMICS
MINS: ANGLE OF ATTACK/ DYNAMIC STABILITY/ HARMONIC
GENERATORS/ LOW SPEED WIND TUNNELS/ PITCHING MOMENTS
ABA: A.R.H.
ABS: A low speed wind tunnel equipped with a axial gust
generator to simulate the aerodynamic environment of a
helicopter rotor was used to study the dynamic stall
table of a pitching blade in an effort to ascertain to what
extent harmonic velocity perturbations in the
freestream affect dynamic stall. The aerodynamic
moment on a two dimensional, pitching blade model in
both constant and pulsating freestream was measured. An
operational analog computer was used to perform
on-line data reduction and plots of moment versus
angle of attack and work done by the moment were
obtained. The data taken in the varying freestream
were then compared to constant freestream data and to
the results of two analytical methods. These
comparisons show that the velocity perturbations have
a significant effect on the pitching moment which can
not be consistently predicted by the analytical
methods, but had no drastic effect on the blade
stability.

B1N31549* ISSUE 22 PAGE 3067 CATEGORY 37
RPT #: NASA-CR-165375 SKF-AT811014 CNT #: NAS3-20839
B1/06/00 260 PAGES UNCLASSIFIED DOCUMENT
UTIL: Development of small bare, high speed tapered roller
bearings/ TSLP: Final Report, May 81
AUTH: A/MORRISON, F. R.; B/GASSEL, S. S.; C/BOVENKERN, R.
L.
AVAIL.NIIS: SAP: HC A17/MF A01
MAJS: /HIGH SPEED/ROLLER BEARINGS/ SUSPENSION SYSTEMS
(VEHICLES)/ TAPERED COLUMNS/ TRANSMISSIONS (MACHINE
ELEMENTS)
MINS: / HELICOPTER DESIGN/ SHAFTS (MACHINE ELEMENTS)/
STRUCTURAL DESIGN/ STRUCTURAL MEMBERS
ABA: E.A.K.
ABS: The performance of four rolling bearing configurations
for use on the input pinion shaft of a proposed
commercial helicopter transmission was evaluated. The
performance characteristics of a high speed tapered
roller bearing operating under conditions comparable
to those existing at this input pinion shaft were
defined. The tapered roller bearing shaft support
configuration was developed for the gearbox using
commercially available bearing designs. The
configuration was optimized and interactive
thermomechanically system analyzed. Automotive pinion
quality tapered roller bearings were found to be
reliable under load and speed conditions in excess of
those anticipated in the helicopter transmission.
However, it is indicated that the elastohydrodynamic
lubricant films are inadequate.

B1N31213* ISSUE 22 PAGE 3018 CATEGORY 7 CNT #: NAS2-10722 B1/00/00 12 PAGES UNCLASSIFIED
UTIL: Helicopter propulsion system reliability and engine
monitoring assessments
AUTH: A/MURPHY, J. A.
CORP: Textron Bell Helicopter, Fort Worth, Tex.
AVAIL.NIIS: SAP: HC A17/MF A01
In NASA; Lewis Res. Center Aircraft Engine Diagnostics p 311-322 (SEE N81-31196 22-07)
MAJS: /ENGINE MONITORING INSTRUMENTS/ HELICOPTERS/
PROPELLER SYSTEM PERFORMANCE/ RELIABILITY ENGINEERING
MINS: / ACCIDENT INVESTIGATION/ ENGINE DESIGN/ FAILURE
ANALYSIS/ LIFE (DURABILITY)/ MAINTAINABILITY
ABA: R.C.T.
ABS: The major short life, unreliable, and high maintenance
engine and power components and subsystems in current
civil helicopters were identified. Categories included
both reciprocating and turbine engines, single and
multiple engine configurations, single and tandem
rotor vehicles, and light, medium, and heavy
helicopters. The major focus was on the following
parameters: accident rate data; maintenance rate data;
and direct operator input.

B1N29135* ISSUE 20 PAGE 2728 CATEGORY 8 RPT #: NASA-CR-166233 ASRL-TR-196-3 CNT #: NSG-2266
B1/08/00 B2 PAGES UNCLASSIFIED DOCUMENT
UTIL: Testing and evaluation of a stall-flutter suppression
system for helicopter rotors using individual-blade-control
AUTH: A/QUACKENBUSH, T. R.
CORP: Massachusetts Inst. of Tech., Cambridge. CSS: ( Aerodynamic and Structures Research Lab.)
AVAIL.NIIS: SAP: HC A05/MF A01
MAJS: / HELICOPTER DESIGN/ HELICOPTERS/ PERFORMANCE TESTS/
ROTARY WINGS/ SYSTEMS ENGINEERING
MINS: / AERODYNAMIC STALLING/ MATHEMATICAL MODELS /
OSCILLATIONS/ WIND TUNNEL TESTS
ABA: Author
ABS: The development and testing of a feedback system
designed to alleviate the violent blade first torsion
mode oscillations associated with stall flutter are
described. The system, based on previously developed
M.I.T. Individual-Blade-Control hardware, employs
blade-mounted accelerometers to sense torsional
oscillations and feed back rate information to
increase the damping of the first torsion mode. A
lineage study of the blade and control system dynamics
is developed and is used to give qualitative and

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quantitative guidance in the design process as well as to aid in analysis of experimental results. System performance in wind tunnel tests, both in hover and forward flight, is described, and evidence is given of the system's ability to provide substantial additional damping to stall-induced blade oscillations.

B1N29034# ISSUE 19 PAGE 2712 CATEGORY B5
RPT#: NASA-CR-164642
CMT#: NASA-2342
00/00/00 40
PAGES UNCLASSIFIED DOCUMENT

UTIL: NASA's aeronautics program: Systems technology and experimental program TSLP: Final Report
MAJS: /AERONAUTICAL ENGINEERING/*NASA PROGRAMS/*OPERATIONS RESEARCH/*RESEARCH MANAGEMENT
MINS: /GOALS/PRIORITY RESEARCH AND DEVELOPMENT/TECHNOLOGY UTILIZATION
ABA: T.M.
ABS: The appropriateness of the division of effort between the directed to the solution of near-term problems and that directed to long-term technical advances in the program is addressed. Comparisons between in-house and out-of-house work are presented. Programs include those in: general aviation; propulsive lift; rotocraft; avionics and flight controls; small transport aircraft; and human/vehicle systems.

B1N29030# ISSUE 19 PAGE 2712 CATEGORY B3
RPT#: NASA-CR-166151
CMT#: NASA-10404
81/01/00 204 PAGES UNCLASSIFIED DOCUMENT

UTIL: Assessment of historical and projected segments of US and world civil and military rotorcraft markets, 1960 - 1990
AUTH: A.YATES, W. J.
CORP: Textron Bell Helicopter, Fort Worth, Tex.
AVAIL.NTIS SAP: HC A01/MF A01
MAJS: /AIRCRAFT PRODUCTION/*HELICOPTERS/*MARKET RESEARCH/*TECHNOLOGICAL FORECASTING
MINS: /CIVIL AVIATION/GRAPHS (CHARTS)/GROSS NATIONAL PRODUCT/MILITARY AVIATION/SERVICE LIFE/TABLES (DATA)
ABA: A.R.H.
ABS: The geographic climatic, political, economic and demographic environment of 75 countries was analyzed with respect to helicopter procurement history and used as key environmental indicators which were variables were projected into strengths and weaknesses of U.S. technology are reviewed. The civil market sensitivity to new technology is forecast with selected premises as to vehicle life, noise standards.

fuel costs. GNP expansion and traffic growth. The forecast is based on a scenario of helicopter technology improvements resulting in increased size and performance.

B1N28073# ISSUE 19 PAGE 2575 CATEGORY 4 RPT#: NASA-CR-166168 B-5316
CMT#: NASA ORDER A-80182-2
81/05/00 93 PAGES UNCLASSIFIED DOCUMENT

UTIL: CIVIL application of differential GPS using a single channel sequential receiver TSLP: Final Report
CORP: Bagnavox Co., Torrance, Calif.
AVAIL.NTIS SAP: HC A03/MF A01
MAJS: /CHANNELS (DATA TRANSMISSION)/CIVIL AVIATION/GLOBAL POSITIONING SYSTEM/RADIO NAVIGATION/RECEIVERS/*SEQUENCING
MINS: /POSITION INDICATORS/SATellite NAVIGATION SYSTEMS
ABA: E.A.K.
ABS: The Global Positioning System (GPS) and its potential for area navigation, landing, and takeoff under minimum ceilings and advanced air traffic control operation is discussed. The following topics are reported: status of the GPS system; GPS signal availability for the civil community; alternative differential GPS concepts; predicted performance enhancement achievable with differential GPS and the operational improvements which will result; and a development program to test and evaluate differential GPS concepts, performance and operational procedures applicable to helicopters. Potential benefits which will be derived from helicopter use of GPS in the differential mode are identified.

B1N27076# ISSUE 18 PAGE 2431 CATEGORY 5 RPT#: NASA-CR-165667
CMT#: NASA-18211
81/06/00 142 PAGES UNCLASSIFIED DOCUMENT

UTIL: Total main rotor isolation system analysis
AUTH: A/HALWES, D. R.
CORP: Textron Bell Helicopter, Fort Worth, Tex.
AVAIL.NTIS SAP: HC A01/MF A01
MAJS: /ISOLATION/*ROTOR AERODYNAMICS/*ROTORs/VIBRATION ISOLATORS
MINS: /HELICOPTERS/VIBRATIONAL STRESS/VIBRATORY LOADS
ABA: Author
ABS: The requirements for a preliminary design study and verification procedure for a total main rotor isolation system at n/rev are established. The system is developed and analyzed, and predesign drawings are created for an isolation system that achieves over 95 percent isolation of all six degrees of freedom.
examined from the point of view of legislation, economics and finance; petroleum; manpower; metallic materials. General aviation; military aviation; transport and industrial aircraft developments; and helicopter. Possible NASA assistance to DOD and the FAA is examined and the evolution of NASA and NASA in aeronautics and of NASA's aeronautics capabilities are described.

This report describes a preliminary design study for a Very Heavy Lift Helicopter (VHLH) that is powered by jets at the blade tips and is controlled by circulation control applied to the main rotor blades. The main thrust of the program was to integrate a tip-jet-powered helicopter design computer program developed by Hughes Helicopters, Inc. (HHI) with circulation control data generated by the David Taylor Naval Ship Research and Development Center (DINSRDC). This work combined the computer program integration work with an air vehicle preliminary design study to size the helicopter and describe its features. The results of this study is a single main rotor helicopter with a 105 foot diameter, two-bladed main rotor that is designed to carry the XM-1 Main Battle Tank 100 nautical miles in a ship-to-shore Marine Corps assault mission.
ABA: A.R.H.

ABS: The state of the U.S. aeronautic industry and progressive changes in national priorities as reflected in federal unified budget outlays are reviewed as well as the contribution of NASA and the character and substance of U.S. aeronautical research under NASA. Eight possible roles for the future defined by NASA are examined and the extent to which the agency should carry out these activities is considered. The roles include: (1) national facilities expertise; (2) flight sciences research; (3) generic technology evolution; (4) vehicle class evolution; (5) technology demonstration; (6) prototype development; (7) technology validation; and (8) operations feasibility. How NASA's roles varies in the areas of military aviation, general aviation, transport aircraft aeronautics, rotorcraft aeronautics, engineering education, information dissemination, and cooperation with other organizations and agencies is discussed with regard to research in aerodynamics; structures and materials: propulsion; electronics and avionics; vehicle operations; and human engineering.

B1N25768# ISSUE 16 PAGE 2248 CATEGORY 41
RPT#: NASA-CR-165715 CNT#: NAS1-15740 81/04/00 75 PAGES UNCLASSIFIED DOCUMENT

UTIL: Validation of helicopter noise prediction techniques


AUTH: A/SUCCI, G. P.


AVAIL: NTIS SAP: HC AO4/MA A01

MAJS: /COMPUTER PROGRAMS/HOILCRAFT/NOISE (SOUND)/PREDICTION ANALYSIS TECHNIQUES/ROTOR WINGS

MINS: /ACOUSTICS/NOISE INTENSITY/PREDICTIONS/PROVING/ROTARY WING AIRCRAFT/ROTORS

ABA: Author

ABS: The current techniques of helicopter rotor noise prediction attempt to describe the details of the noise field precisely and remove the empiricisms and restrictions inherent in previous methods. These techniques require detailed inputs of the rotor geometry, operating conditions, and blade surface pressure distribution. The purpose of this paper is to review those techniques in general and the Farassat/Nystrom analysis in particular. The predictions of the Farassat/Nystrom noise computer program, using both measured and calculated blade surface pressure data, are compared to measured noise level data. This study is based on a contract from NASA to Bolt Beranek and Newman Inc. with measured data from the AH-1G Helicopter Operational Loads Survey flight test program supplied by Bell Helicopter Textron.

B1N25090# ISSUE 16 PAGE 2155 CATEGORY 8
RPT#: NASA-CR-165665 SER-70471 CNT#: NAS1-16168 81/04/00 59 PAGES UNCLASSIFIED DOCUMENT

UTIL: Main rotor six degree-of-freedom isolation system analysis

TCLP: Final Report

AUTH: A/EASTMAN, L. B.

CORP: Sikorsky Aircraft, Stratford, Conn.

AVAIL: NTIS SAP: HC AO4/MA A01

MAJS: /ATTENUATORS/ISOLATORS/ROTOR WINGS/UH-60A HELICOPTER

MINS: /DEGREES OF FREEDOM/HELICOPTER PROPPELLER DRIVE/Shock ABSORBERS/SYSTEMS ANALYSIS

ABA: T.M.

ABS: The design requirements of this system have been defined and an isolator concept satisfies these requirements identified. Primary design objectives for the isolation system are 90% attenuation of all NP main rotor shaft loads at a weight penalty less than or equal to 1% of design gross weight. The configuration is sized for a UH-60A BLACK HAWK helicopter and its performance, risk, and system integration were established through a series of parametric studies. Preliminary design analyses were used as an input to the detailed design and the details of the integration of the isolator into the helicopter system are considered. Alternate ground and flight test demonstration programs necessary to verify the proposed isolator design are defined.

B1N23070# ISSUE 16 PAGE 1861 CATEGORY 5
RPT#: NASA-CR-165344 D210-11662-1 CNT#: NAS3-22384 81/05/00 116 PAGES UNCLASSIFIED DOCUMENT

UTIL: Rotorcraft aviation icing research requirements: Research review and recommendations

TCLP: Final Report

AUTH: A/PETTERSON, A. A.; B/DADONE, L.; C/BEVAN, A.


AVAIL: NTIS SAP: HC AO6/MA A01

MAJS: /AIRCRAFT HAZARDS/CERTIFICATION/ICE FORMATION/ICE PREVENTION/ROTOR WING AIRCRAFT/TECHNOLOGY ASSESSMENT

MINS: /DEICING/ENGINE INLETS/ENVIRONMENT SIMULATION/FLIGHT TESTS/PROTECTION

ABA: A.R.H.

ABS: The status of rotorcraft icing evaluation techniques and ice protection technology was assessed. Recommendations are made for near and long term icing programs that describe the needs of industry. These recommended programs are based on a consensus of the major U.S. helicopter companies. Specific activities currently planned or underway by NASA, FAA and DOD are reviewed to determine relevance to the overall
research requirements. New programs, taking advantage of current activities, are recommended to meet the long term needs for rotorcraft icing certification.

modification of the airframe, hub or upper controls. Provision of a low risk nonmechanical control system was also studied, and a development specification is given.

The INDES computer program, a multistep input design program used as part of a data processing technique for rotorcraft systems identification, is described. Flight test inputs base on INDES improve the accuracy of parameter estimates. The input design algorithm, program input, and program output are presented.

The computer program, OSR (Optimal Subset Regression) which estimates models for rotorcraft body and rotor force and moment coefficients is described. The technique used is based on the subset regression algorithm. Given time histories of aerodynamic coefficients, aerodynamic variables, and control inputs, the program computes correlation between various time histories. The model structure determination is based on these correlations. Inputs and outputs of the program are given.

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may be applied to systems modeled by linear
constant-coefficient differential equations. This
restriction in scope allows the application of several
analytical results which simplify the computation
and improve its efficiency over the general nonlinear
case.

B1N227722# ISSUE 13 PAGE 1811 CATEGORY 61
RPT#: NASA-CR-159081 CNT#: NAS1-14549 75/11/00
69 PAGES UNCLASSIFIED DOCUMENT
UTL: DEREKIS user's guide: Discrete Extended Kalman
Filter/Smoother program for aircraft and rotorcraft
data consistency
CORP: Systems Control, Inc., Palo Alto, Calif. AVAIL.NTIS
SAP: HC A04/MA 01
MAJS: /*COMPUTER PROGRAMS/ DATA SMOOTHING/ FIXED WINGS/
KALMAN FILTERS/ ROTARY WING AIRCRAFT
MINS: / ALGORITHMS/ COMPUTER PROGRAMMING/ ERROR CORRECTING
DEVICES/ ESTIMATING/ INSTRUMENT ERRORS/ LINEARIZATION/
NONLINEAR EQUATIONS/ USER MANUALS (COMPUTER PROGRAMS)
ABA: M.G.
ABS: The computer program DEREKIS (discrete extended Kalman
filter/smoother), formulated for aircraft and
helicopter state estimation and data consistency. It
is described. DEREKIS is set up to pre-process raw test
data by removing biases, correcting scale factor
errors, and providing consistency with the aircraft
 inertial kinematic equations. The program implements
an extended Kalman filter/smoother using the
Friedland-Duffy formulation.

B1N22407# ISSUE 13 PAGE 1718 CATEGORY 6
RPT#: NASA-CR-152220 CNT#: NAS2-10326 80/01/00 381
PAGES UNCLASSIFIED DOCUMENT
UTL: V/STOLAND digital avionics system for XV-15 tilt rotor
TSP: Final Report
AUTH: A/LIDEN. S.
SAP: HC A17/MA 01
MAJS: /*AUTOMIL FLIGHT SYSTEMS/MILITARY SYSTEMS/ TILT ROTOR RESEARCH
AIRCRAFT/ V/STOL AIRCRAFT/ XV-15 AIRCRAFT
MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AIRCRAFT GUIDANCE/
AIRCRAFT LANDING/ ARCHITECTURE (COMPUTERS)/ DISPLAY
DEVICES
ABA: A.R.M.
ABS: A digital flight control system for the tilt rotor research aircraft provides sophisticated navigation,
guidance, control, display and data acquisition
capabilities for performing terminal area navigation.
Guidance and control research. All functions of the
XV-15 V/STOL system were demonstrated on the

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NASA-ARC S-19 simulation facility under a comprehensive dynamic acceptance test. The most noteworthy accomplishments of the system are: (1) automatic configuration control of a tilt-rotor aircraft over the total operating range; (2) total hands-off landing to touchdown on various selectable straight-in glide slopes and on a flight path that includes a two-revolution helix; (3) automatic guidance along a programmed three-dimensional reference flight path; (4) navigation data for the automatic guidance computed on board, based on VOR/DME, TACAN, or MLS navigation data; and (5) integration of a large set of functions in a single computer, utilizing 16k words of storage for programs and data.

B11910N2# ISSUE 10 PAGE 1305 CATEGORY 6 RPT#: NASA-91-15217 CNT#: NASA-7306 78/10/00 216 PAGES UNCLASSIFIED DOCUMENT
UTIL: V/STOL AND digital avionics system for UH-1H TLSP: Final Report
AUTH: A/LIDEN, S.
CORP: Sperry Flight Systems, Phoenix, Ariz. AVAIL.NTIS
SAP: HC A12/MA01
MAJS: /AERP/NA,AVIONICS/DIGITAL SYSTEMS/
HELICOPTER CONTROL/MILITARY HELICOPTERS
MINS: / BELL AIRCRAFT/ COMPUTERIZED SIMULATION/ DATA
ACQUISITION/ DIGITAL COMPUTERS/ DISPLAY DEVICES/
FLIGHT SIMULATION
ABA: T.M.
ABS: An integrated methodology for rotorcraft system identification consists of rotorcraft mathematical modeling, three distinct data processing steps, and a technique for designing inputs to improve the identifiability of the data. These elements are as follows: (1) a Kalman filter smoother algorithm which estimates states and sensor errors from error corrupted data. Gust time histories and stability also be estimated; (2) a model structure estimation algorithm for isolating a model which adequately explains the data; (3) a maximum likelihood algorithm for estimating the parameters and estimates for variance of these estimates; and (4) an input design algorithm, based on a maximum likelihood approach, which provides inputs to improve the accuracy of parameter estimates. Each step is discussed with examples to both flight and simulated data cases.

B11910O8# ISSUE 9 PAGE 1144 CATEGORY 2 RPT#: NASA-15225 R-1562 CNT#: NASA-8726 79/01/15 170 PAGES UNCLASSIFIED DOCUMENT
UTIL: Multicyclic controllable twist rotor data analysis TLSP: Final Report
AUTH: A/WEI, F. S.; B/WEISBRICH, A. L.
CORP: Kaman Aerospace Corp., Bloomfield, Conn. AVAIL.NTIS
SAP: HC A08/MA01
MAJS: / BENDING MOMENTS/CONTROLLABILITY/OPTIMIZATION/
ROTARY WINGS/ ROTOR AERODYNAMICS/ WIND TUNNEL TESTS
MINS: / AERP/CHARACTERISTICS/ AERP/STABILITY/
BENDING VIBRATION/HELICOPTER PERFORMANCE/ LOADING
MOMENTS/ REGRESSION ANALYSIS
ABA: T.M.
ABS: Results provide functional relationship between rotor performance, blade vibratory loads and dual control settings and indicate that multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads. Higher harmonic terms of servo flap deflection were found to be most pronounced in flatwise bending moment, transmission vertical vibration and pitch link vibratory load equations. The existing test hardware represents a satisfactory configuration for demonstrating MTOR technology and defining a data base for additional wind tunnel testing.
B1N7331# ISSUE 8 PAGE 1113 CATEGORY 66 RPT#:
NASA-CR-152202 CN#: NASA2-9826 78/12/00 390 PAGES
UNCLASSIFIED DOCUMENT
UTTL: Study of civil markets for heavy-lift airships
AUTH: A/NETTAM, P. J.; B/HANSEN, D.; C/CHABOT, C.;
D/BYRNE, R.
AVAIL. NTIS: SAP: HC A17/MF A01
MAJS: /DESIGN ANALYSIS/ HEAVY LIFT HELICOPTERS/MARKET
RESEARCH/PRODUCT DEVELOPMENT/USER REQUIREMENTS
MINS: / AIR CARGO/ ECONOMIC ANALYSIS/ HELICOPTER DESIGN/
MARKETING/ MILITARY OPERATIONS
ABA: T.M.
ABS: The civil markets for heavy lift airships (HLAs) were
defined by first identifying areas of most likely
application. The operational suitability of HLAs for
the applications identified were then assessed. The
operating economics of HLAs were assessed and the
market size was estimated by comparing
HLA operating and economic characteristics with those
of competing modes. The sensitivities of the market
size to HLA characteristics were evaluated and the
number and sizes of the vehicles required to service
the more promising markets were defined. Important
characteristics for future HLAs are discussed that
were recommended from the study of each application.
Including operational requirements, features enhancing
profitability, military compatibility, improved design
requirements, approach to entry into service, and
institutional implications for design and operation.

B1N14560# ISSUE 5 PAGE 651 CATEGORY 47
80/03/00 5 PAGES UNCLASSIFIED DOCUMENT
UTTL: Aircraft icing instrumentation: Unfilled needs ---
rotary wing aircraft
AUTH: A/H KITCHENS, P. F.
CORP: Army Test and Evaluation Command, Aberdeen Proving
Ground, Md. AVAIL. NTIS: SAP: HC A13/MF A01
In NASA, Marshall Space Flight Center Procs. Fourth
Ann. Workshop on Meteorol. and Environ. Inputs to
Aviation Systems p 61-63 (SEE N81-14555 05-47)
MAJS: / ATMOSPHERIC TEMPERATURE/ICE FORMATION/
METEOROLOGICAL PARAMETERS/ROTARY WING AIRCRAFT
SPECIFICATIONS/ ATMOSPHERIC MOISTURE/ DROP
SIZE/ DROPS (LIQUIDS)/ SOLAR RADIATION
ABA: R.C.T.
ABS: A list of icing instrumentation requirements are
presented. Because of the Army's helicopter
orientation, many of the suggestions are specific to
rotary wing aircraft; however, some of the
instrumentation are also suitable for general aviation
aircraft.

B1N12110# ISSUE 3 PAGE 307 CATEGORY B RPT#:
NASA-CR-152306 TR-1127-1-VOL-2 CN#: NASA2-9846
79/03/00 254 PAGES UNCLASSIFIED DOCUMENT
UTTL: Practical optimal flight control system design for
helicopter aircraft; Volume 2: Software user's guide
TSLP: Final Report
AUTH: A/RIEDEL, S. A.
AVAIL. NTIS: SAP: HC A12/MF A01
MAJS: / COMPUTER SYSTEMS DESIGN/ CONTROL THEORY/ FLIGHT
CONTROL/HELICOPTER CONTROL/ OPTIMAL CONTROL
MINS: / KALMAN FILTERS/ USER MANUALS (COMPUTER PROGRAMS)/
USER REQUIREMENTS
ABA: U.S.
ABS: A method by which modern and classical control theory
techniques may be integrated in a synergistic fashion
and used in the design of practical flight control
systems is presented. A general procedure is
developed, and several illustrative examples are
included. Emphasis is placed not only on the synthesis
of the design, but on the assessment of the results as
well. The first step is to establish the differences
disturbing characteristics and connections between
the modern and classical control theory approaches.
Ultimately, this uncovers a relationship between
bandwidth goals familiar in classical control and cost
function weights in the equivalent optimal system. In
order to obtain a practical optimal solution, it is
also necessary to formulate the problem very
carefully, and each choice of state, measurement and
output variable must be judiciously considered. Once
design goals are established and problem formulation
completed, the control system is synthesized in a
straightforward manner. Three steps are involved:
filter-observer solution, regulator solution, and the
combination of those two into the controller.
Assessment of the controller permits and examination
and expansion of the synthesis results.
ABA: GRA

ABS: Head up displays are the subject of this retrospective survey of much of the world aerospace literature. Development, fabrication and use, and applications to specific aircraft, such as the F-4E, Jaguar, Tornado, F-18, Viggen, A-10, AV-8B, Sea Harrier, Space Shuttle, helicopters, KC-135, and in commercial aircraft, are discussed. A look at the future in this field is also presented. Contains 70 citations.

B1110019* ISSUE 1 PAGE 4 CATEGORY 3 RPT#: NASA-CR-152390 FR-MTR(IC) 80-13 VOL-2 CNT#: NAS2-10505 80/10/00 221 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/TOUSEL, C. H.; B/BRENNAN, M. F.


MAJS: /*AIRCRAFT HAZARDS/*COLLISIONS/*HELICOPTERS/*PILOT ERROR/*ROTARY WINGS/*WIRE

MINS: /AIRCRAFT ACCIDENTS/ FLIGHT HAZARDS/ GENERAL AVIATION AIRCRAFT

ABA: M9

ABS: A description and analysis of each of the 208 civil helicopter wire strike accidents reported to the National Transportation Safety Board (NTSB) for the ten year period 1970-1979 is given. The accident analysis briefs were based on pilot reports, FAA investigation reports, and such accident photographs as were made available. Briefs were compiled by year and, within year, by NTSB accident report number.

BON33390* ISSUE 24 PAGE 323J CATEGORY 5 RPT#: NASA-CR-3312 REPT-4300 CNT#: NAS2-10145 80/10/00 165 PAGES UNCLASSIFIED DOCUMENT

UTTL: Pilot/vehicle model analysis of visual and motion cue requirements in flight simulation -- helicopter hovering. TLSP: Final Report

AUTH: A/BARON, S.; B/LANCRAFT, R.; C/ZACHARIAS, G.

CORP: Bolt, Beranek, and Newman, Inc. Cambridge, Mass. AVAIL. NTIS SAP: HC ABB/MF AO1

MAJS: /*DIGITAL SIMULATION/*FLIGHT SIMULATION/*HELICOPTER CONTROL/*MOTION PERCEPTION/*PILOT PERFORMANCE/*VISUAL PERCEPTION

MINS: /DISPLAY DEVICES/ FIELD OF VIEW/ HOVERING/ TASK COMPLEXITY/ TIME LAG/ VISUAL TASKS

ABA: Author

ABS: The optimal control model (OCM) of the human operator is used to predict the effect of simulator characteristics on pilot performance and workload. The flying task studied is helicopter hover. Among the simulator characteristics considered were (computer generated) visual display resolution, field of view and time delay.

BON33381* ISSUE 24 PAGE 323I CATEGORY 3 RPT#: NASA-CR-152389 HUMANO FR-MTR(ICA) 80-13 CNT#: NAS2-10505 80/10/00 66 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/TUONGELA, C. H.; B/BRENNAN, M. F.

CORP: Human Resources Research Organization. Alexandria, Va. AVAIL. NTIS SAP: HC ABO/MF AO1

MAJS: /*AIRCRAFT ACCIDENT INVESTIGATION/*CIVIL AVIATION/*HELICOPTERS/*WIRE

MINS: /COLLISION AVOIDANCE/ FLIGHT HAZARDS/ PILOT PERFORMANCE/ TRANSMISSION LINES
accidents for a ten-year period, 1970 to 1979, are analyzed. It is found that 83% of the wire strikes occurred during bright clear weather. Analysis of the accidents is organized under pilot, environment, and machine factors. Methods to reduce the wire strike accident rate are discussed, including detection/warning devices, identification of wire locations prior to flight, wire cutting devices, and implementation of training programs. The benefits to be gained by implementing accident avoidance methods are estimated to be fully justified by reduction in injury and death and reduction of aircraft damage and loss.

BON33351# ISSUE 24 PAGE 3227 CATEGORY 2 RPT#: NASA-CR-152366 SER-510034 CNT#: NAS2-10211 80/07/00 169 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/Jeppson, D.; B/Moffitt, R.; C/Hilzinger, J. B.
CORP: Sikorsky Aircraft, Stratford, Conn. AVAIL.NTIS SAP: HC A08/00 ADI

MAJ: /AERODYNAMICS*DATA CORRELATION*HELICOPTER PERFORMANCE*ROTOR AERODYNAMICS*VIBRATORY LOADS*WIND TUNNEL TESTS

MINS: /ATOMIC PROFILES*BLADE TIPS*HOVERING STABILITY*PREDICTION ANALYSIS TECHNIQUES*SCALE MODELS*STIFFNESS

ABA: A.R.H.

ABS: The performance and blade vibratory loads characteristics of an advanced rotor system as predicted by analysis and as measured in a 1/5 scale model wind tunnel test, a full scale model wind tunnel test and flight test were compared. The 1/5 scale model rotor predicted conservative full scale rotor performance as expected due to Reynolds number effects. Although blade vibratory moment trends with advance ratio were predicted by the 1/5 scale model, the absolute values of the blade vibratory moments were underpredicted. The full scale model predicted forward flight performance within 9% of Blade vibratory loads, however, were underpredicted. The result of rotor inflow distortions imparted by the flow over the fuselage. The coupled normal modes of (M1) elastic rotor blade analysis incorporating the variable inflow was able to predict most of the trends of the test data at the higher advance ratios, but was unable to predict the absolute magnitude of the blade 1/2 peak to peak moments at all cruise speed and rotor lift conditions.
objective of which was to overcome the excessive brittleness of the previously developed UH-1 helicopter tail rotor drive shaft design which demonstrated a shaft train weight savings of 53.1% over the current 2024-T3 aluminum shaft train. A materials impact program demonstrated exceptionally noteworthy performance of two woven constructions containing E-glass and PRD 49-III (designation later changed to KEVLAR 49) fibers in an epoxy resin matrix. Thermoset matrices and PRD 49-III fiber provided impact resistance at low weight which was superior to composites having the same fiber in a thermoset resin matrix. A design, fabrication, and test program showed that shaft impact resistance could be improved over the previously developed graphite composite design at a cost in shaft train rate savings. The shaft train weight savings of the most impact tolerant construction was 4.0% over the current aluminum shaft train. Alternating plies of graphite and glass appear to provide substantially greater tube impact durability than that provided by hybridization of the two fibers into one tape wound to a ply design equivalent in strength and stiffness to that of the alternating ply design. Recommendations were made to continue research work to exploit the potential for new impact-durable structures through the use of KEVLAR 49 fiber, woven structures, thermoset matrices and THORNE 50-S/KEVLAR 49 blends with thermoset matrices.

BON29369# ISSUE 19 PAGE 2524 CATEGORY B RPT#: NASA-CR-152377 CNT#: NAS2-10121 00/07/00 165 PAGES UNCLASSIFIED DOCUMENT UTLT: Analytical design and evaluation of an active control system for helicopter vibration reduction and gust response alleviation AUTH: KIRKWOOD, P. B.; B/ZWICKE, P. E.; C/GOLD, P.; D/MIAO, W.

CORP: United Technologies Research Center, East Hartford, Conn.; Sikorsky Aircraft, Stratford, Conn.

AVAIL: NTIS SAP: HC A06/IA A07

MAJS: /*ACTIVE CONTROLS/GUST ALLEVIATORS/HELICOPTER CONTROL/ROTOR AERODYNAMICS/VIBRATION DAMPING/WIND EFFECTS

MINS: AIRBORNE/SPACEBORNE COMPUTERS/REAL TIME OPERATION

ABA: E/D K.

ABS: An analytical study was conducted to define the basic configuration of an active control system for helicopter vibration and gust response alleviation. The study culminated in a control system design which has two separate systems: narrow band loop for vibration reduction and wider band loop for gust response alleviation. The narrow band vibration loop utilizes the standard swashplate control configuration to input controller for the vibration loop is based on adaptive optimal control theory and is designed to adapt to any flight condition including maneuvers and transients. The prime characteristics of the vibration control system is its real time capability. The gust alleviation control system studied consists of optimal sampled-data feedback laws together with an optimal one-step-ahead prediction. The prediction allows the estimation of the gust disturbance which can then be used to minimize the gust effects on the helicopter.

BON28330# ISSUE 19 PAGE 2518 CATEGORY 4 RPT#: NASA-CR-152367 CNT#: NAS2-10291 00/07/00 124 PAGES UNCLASSIFIED DOCUMENT UTLT: Analytical methodology for determination of helicopter IFR precision approach requirements -- pilot workload and acceptance level

AUTH: A/PHATAK, A. V.


AVAIL: NTIS SAP: HC A06/IA A07

MAJS: /*APPROACH CONTROL/GLIDE PATHS/HELICOPTER CONTROL/INSTRUMENT FLIGHT RULES/LANDING SIMULATION/PILOT PERFORMANCE

MINS: AIRCRAFT LANDING/ALL-WEATHER LANDING SYSTEMS/MANS MACHINE SYSTEMS/TASK COMPLEXITY/UH-1 HELICOPTER

ABA: Author

ABS: A systematic analytical approach to the determination of helicopter IFR precision approach requirements is formulated. The approach is based upon the theory that pilot acceptance level or opinion rating of a given system is inversely related to the degree of pilot involvement in the control task. A nonlinear simulation of the helicopter approach to landing task incorporating appropriate models for UH-1 aircraft, the environmental disturbances and the human pilot was developed as a tool for evaluating the pilot acceptance hypothesis. The simulated pilot model is generic in nature and includes analytical representation of the human information acquisition, processing, and control strategies. Simulation analyses in the flight director mode indicate that the pilot model used is reasonable. Results of the simulation are used to identify candidate pilot workload metrics and to test the well known performance-workload relationship. A pilot acceptance analytical methodology is formulated as a basis for further investigation, development and validation.
A preliminary design for a helicopter/VSTOL wide angle simulat image generation display system is studied. The visual system is to become part of a simulator capability to support Army aviation systems research and development within the next term. As required for the Army to simulate a wide range of aircraft characteristics, versatility and ease of changing cockpit configurations were primary considerations of the study. Due to the Army's interest in low altitude flight and descents into and landing in constrained areas, particular emphasis is given to wide field of view, resolution, brightness, contrast, and color. The visual display study includes a preliminary design, demonstrated feasibility of advanced concepts, and a plan for subsequent detail design and development. Analysis and tradeoff considerations for various visual system elements are outlined and discussed.

marginally. The maximum lift requirement at $M = 0.5$ and most of the profile drag objectives cannot be met without some compromise of at least one of the higher order priorities.
Some of the power train transmission gears in helicopter drive systems can become critical components as performance requirements are increased. Increasing attention must be paid to new alloys in order to obtain required performance reliability and survivability. Candidate advanced alloys with improved high temperature properties, which increase the resistance to scoring and spalling, tend to have lower ductility and fracture toughness. An attempt is made to identify design materials, and processing problems and requirements. In addition, it is recommended that the characterization of candidate steels be accelerated: preliminary investigation indicates that new alloys may provide improved capability against surface distress.

Analysis of vibratory excitation of gear systems as a contributor to aircraft interior noise — helicopter cabin noise

A method by which modern and classical theory techniques may be integrated in a synergistic fashion and used in the design of practical flight control systems is presented. A general procedure is developed, and several illustrative examples are included. Emphasis is placed not only on the synthesis of the design, but on the assessment of the results as well.
BON22305# ISSUE 13 PAGE 1665 CATEGORY 5 RPT#: NASA-CR-159215 CNT#: NAS2-8703 80/01/00 179 PAGES UNCLASSIFIED DOCUMENT
UTILITY: Parametric study of helicopter aircraft systems costs
AUTH: A/BELTRAND, M. N.
CORP: Science Applications, Inc., Los Angeles, Calif. CSS: (Economic Analysis Div.) AVAIL.NTIS SAP: HC AOG/FF A01
MAJLS: /AIRCRAFT DESIGN/AVIONICS/HELIICOPTERS/PRODUCTION ENGINEERING
MINS: / COSI ESTIMATES/ PARAMETERIZATION/ SYSTEMS ENGINEERING/ WEIGHT (MASS)
ABA: R. E. S.

ABS: Weight estimating relationships (WERS) and recurring production cost estimating relationships (CERS) were developed for helicopters at the system level. The WERS estimate system level weight based on performance or design characteristics which are available during concept formulation or the preliminary design phase. The CER (or CERS in some cases) for each system utilize weight (either actual or estimated using the appropriate WER) and production quantity as the key parameters.

BON18030# ISSUE 9 PAGE 1692 CATEGORY 5 RPT#: NASA-954-1592310 D210-11260-1-VOL-1 CNT#: NAS2-9015 78/03/00 473 PAGES UNCLASSIFIED DOCUMENT
UTILITY: A helicopter rotor X-1S design integration feasibility study. Volume 1: Engineering design studies TLS: Final Report
AUTH: A/MAGEE, J. P.; B/ALEXANDER, H. R.
MAJLS: /HELIICOPTER DESIGN/RIGID ROTORS/SYSTEMS ENGINEERING
MINS: / FEASIBILITY ANALYSIS/ FLIGHT CHARACTERISTICS/ FLIGHT TESTS/ NOISE REDUCTION/ STRUCTURAL DESIGN/ T-53 ENGINE
ABA: R. E. S.

ABS: A design integration feasibility study was carried out to investigate what modifications to the basic XV-15 are necessary to accomplish a flight demonstration of the XV-15 with a Boeing hingeless rotor. Also investigated were additional modifications which would exploit the full capability provided by the combination of the new rotor and the existing T53 engine. An evaluation of the aircraft is presented and the data indicate improved air vehicle performance, acceptable aerodynamic margins, lower noise levels, and improved flying qualities compared with the XV-15 aircraft. Inspection of the rotor system data provided shows an essentially unlimited life rotor for the flight spectrum anticipated for the XV-15.
field about the dual-bladed rotor was investigated to determine the aerodynamic characteristics for various dual rotor blade placement combinations with respect to blade stagger, gap, and angle of attack between the two blades. The boundary layer separation on the rotors was studied and three dimensional induced drag calculations for the dual rotor system are presented. The thrust and power requirements of the rotor system were predicted. NASPAN employed as the primary modeling tool. was used to obtain a model for predicting in plane bending, out of plane bending, and the torsional behavior of the birotors. Local hub loads, blade loads, and the natural frequencies for the birotor configuration are discussed.

BON16070* ISSUE 7 PAGE 824 CATEGORY 9 RPT#: NASA-CR-152193 CNT#: NAS2-5894 NASA ORDER C-4952-1 7/09/00 150 PAGES UNCLASSIFIED DOCUMENT

UTL: Feasibility and concept study to convert the NASA/AMES vertical motion simulator to a helicopter simulator - TASP: Final Report
AUTH: A/BELSTERNIE, C. A.; B/CHOU, R. C.; C/DAVIES, E. G. ; D/ISU, R. C.
AVA P: STIS SAP: HC A07/MF A01
MAJS: */FLIGHT SIMULATORS/HYDROPLANES/FLIGHT SIMULATORS/* VERTICAL MOTION
MINS: /DEGREES OF FREEDOM/ELEVEN/DRAWING/FEASIBILITY ANALYSIS/SYSTEMS ENGINEERING/ VERTICAL FLIGHT

ABA: R.E.S.

ABS: The conceptual design for converting the vertical motion simulation (VMS) to a multi-purpose aircraft and helicopter simulator is presented. A unique, high performance four degrees of freedom (DOF) motion system was developed to permanently replace the present six DOF synergetic system. The new four DOF system has the following outstanding features: (1) will be integrated with the two large VMS translational and their associated sub-systems; (2) can be converted from helicopter to fixed-wing aircraft simulation through software changes only; (3) interfaces with an advanced cab/visual display system of large dimensions; (4) makes maximum use of proven techniques, conventions, computers, and off-the-shelf components; (5) will operate within the existing building envelope without modifications; (6) can be built within the specified weight limit and avoid compromising VMS performance; (7) provides maximum performance with a minimum of power consumption; (8) simple design minimizes coupling between motions and maximizes reliability; and (9) can be built within existing budgetary figures.
Mathematical modeling and computer mechanization for real time simulation of rotary-wing aircraft are discussed. Error analysis in the digital simulation of dynamic systems, such as rotary wing aircraft, is described. The method for digital simulation of nonlinearities with discontinuities, such as aircraft control systems and rotor blade hinging, is discussed.

The extent of the threat to the U.S. helicopter industry posed by a determined effort by foreign manufacturers, European companies in particular, to supply their own domestic markets and also to penetrate export markets, including the USA, is assessed. Available data on U.S. and world markets for civil and military uses are collated and presented in both graphic and tabular form showing the past history of production and markets and, where forecasts are available, anticipated future trends. The data are discussed on an item-by-item basis and inferences are drawn in as much depth as appears justified.
level in forward flight is also included. In order to

give the designer an assessment of the relative rotor

performance, which may be traded off against noise, an

additional chart for estimating the percent of

available rotor thrust which must be expended in

lifting the rotor and drive system, is included as

well as approach for comparing the subjective

acceptability of various rotors once the absolute

sound pressure levels are predicted.

79N31603* ISSUE 22 PAGE 2960 CATEGORY 37

RPT#: NASA-CR-3155 M#-76TR41 CNT#: NAS5-16824

79/08/00 158 PAGES UNCLASSIFIED DOCUMENT

TTL: Design and application of a test rig for

super-critical power transmission shafts. TLSP: Final

Report

AUTH: A/DARLON, M.; B/SLALLEY, A.

CORP: Mechanical Technology Inc., Latham, N. Y.

AVAIL.NTIS SAP: HC B/MF AD1

Washington, NASA

MAJS: /SHAFTS (MACHINE ELEMENTS)/-STRUCTURAL DESIGN/-TEST

EQUIPMENT/-TEST FACILITIES

MINS: /DAMPING/- FEASIBILITY/- HELICOPTERS/- MECHANICAL DRIVES

/POWER TRANSMISSION/- TORQUE/- UTILIZATION/- VIBRATION

ABA: G.Y.

ABS: The design, assembly, operational check-out and

application of a test facility for testing super-

critical power transmission shafts under

realistic conditions of size, speed and torque

are described. Alternative balancing methods and

alternative damping mechanisms are demonstrated and

compared. The influence of torque upon the unbalance

distribution is studied, and the effect on synchronous

vibrations is investigated. The feasibility of

operating super-critical power transmission shafting is

demonstrated, but need for careful control, by

balancing and damping, of synchronous and

nonsynchronous vibrations is made clear. The facility

was demonstrated to be valuable for shaft system

development programs and studies for both advanced and

current-production hardware.

79N31227* ISSUE 22 PAGE 2907 CATEGORY 8 RPT:

NASA-CR-3145 TR-1087-2-VOL-2 CNT#: NAS5-9344

79/09/00 176 PAGES UNCLASSIFIED DOCUMENT

TTL: A compilation and analysis of helicopter handling

qualities data. Volume 2: Data analysis

AUTH: A/HUFFLEY, R. K.


AVAIL.NTIS SAP: HC A05/MF AD1

MAJS: /AIRCRAFT MANEUVERS/-CONTROLABILITY/-HELICOPTER

CONTROL/-HELICOPTER PERFORMANCE/-HELICOPTERS/-MANUAL

CONTROL/-PILOT PERFORMANCE

MINS: /ATMOSPHERIC TURBULENCE/- DIRECTIONAL STABILITY/

HOVERING STABILITY/- LATERAL CONTROL/- LONGITUDINAL

CONTROL/- PITCH (INCLINATION)/ ROLL/ WIND SHEAR/ YAW

ABA: A.W.H.

ABS: A compilation and an analysis of helicopter handling

qualities data are presented. Multiloop manual control

methods are used to analyze the descriptive data.

Stability derivatives, and transfer functions for a

six degrees of freedom, quasi static model. A

comparative loop structure is applied to coupled

longitudinal, lateral and directional equations in

such a way that key handling qualities features are

examined directly.

79N31221* ISSUE 22 PAGE 2907 CATEGORY B RPT:

NASA-CR-159052 HONEYWELL-795RC3 CNT#: NAS1-14789

79/07/00 171 PAGES UNCLASSIFIED DOCUMENT

TTL: Helicopter high gain control TLSP: Final Report

AUTH: A/CUNNINONNA, T. B.; B/HURL, E. C.

CORP: Honeywell Systems and Research Center, Minneapolis,

Minn. AVAIL.NTIS SAP: HC A08/MF AD1

MAJS: /CH-47 HELICOPTER/-CONTROL EQUIPMENT/-CONTROL THEORY

/FEEDBACK CONTROL/-FLIGHT CONTROL/-HELICOPTER CONTROL

/HIGH GAIN

MINS: /ACTUATORS/- AIRCRAFT MODELS/- AIRCRAFT NOISE/- ATTITUDE

CONTROL/- BANDWIDTH/- CONTROL NOISE/- GYROscopes/

HELICOPTER PERFORMANCE/- NOISE REDUCTION/- ROTARY WINGS

ABA: A.W.H.

ABS: High gain control is explored through a design study of

the CH-47B helicopter. The plans are designed to

obtain the maximum bandwidth possible given the

hardware constraints. Controls are designed with modal

control theory to specific bandwidths and closed loop

maus shape. Comparisons are made to earlier

complementary filter approach. Bandwidth improvement

by removal of limitations is explored in order to

establish hardware and mechanics options.

Improvements in the pitch axis control system and in

the rate gyro sensor noise characteristics in all axes

are discussed. The use of rotor state feedback is

assessed.

79N30180* ISSUE 21 PAGE 2761 CATEGORY 1 RPT:

NASA-CR-152921 CNT#: NAS2-9143 79/08/00 34 PAGES

UNCLASSIFIED DOCUMENT

TTL: Maintenance cost study of rotary wing aircraft, phase

2 TLSP: Interim Report

CORP: Rail Co., Baltimore, Md. AVAIL.NTIS SAP: HC

A03/MF AD1

MAJS: /AIRCRAFT MAINTENANCE/- COST ESTIMATES/- MILITARY

HELICOPTERS/- ROTARY WING AIRCRAFT/- VERTICAL TAKEOFF
Aircraft

MINS: / CORRELATION COEFFICIENTS/ PREDICTION ANALYSIS
TECHNIQUES/ REGRESSION ANALYSIS/ SYSTEMS ANALYSIS

ABA: A.R.H.

ABS: The Navy's maintenance and materials management data base was used in a study to determine the feasibility of predicting unscheduled maintenance costs for the dynamic systems of military rotary wing aircraft. The major operational and design variables were identified and the direct maintenance man hours per flight hour were obtained by step-wise multiple regression analysis. Five nonmilitary helicopter users were contacted to supply data on which variables were important factors in civil applications. These users included offshore oil exploration and support, police and fire department rescue and enforcement, logging and heavy equipment movement, and U.S. Army military operations. The equations developed were highly effective in predicting unscheduled direct maintenance man hours per flying hours for military aircraft, but less effective for commercial or public service helicopters, probably because of the longer mission duration and the much higher utilization of civil users.

79N29894** ISSUE 19 PAGE 2606 CATEGORY 71
RPT#: NASA-CR-15884 AD-A046180 ARO-12931.2-EX
REPT: 83852-1 REPT-78-1 CN#: NSG-2995
DAAG29-76-C-0027 78/01/00 158 PAGES UNCLASSIFIED DOCUMENT


AUTH: A.ARAVANIDAN, K.S.; B/HARRIS, W.L.
CORP: Massachusetts Inst. of techn, Cambridge, CSS: (Fluid Dynamics Research Lab.) AVALIA. NTIS SAP: HC AO9/MF AO1
Submitted for publication

MAJS: / AERODYNAMIC NOISE/ COMPUTERIZED SIMULATION/ HELICOPTERS/ ROTARY WINGS/ ROTOR AERODYNAMICS
MINS: / ANECHOIC CHAMBERS/ FLOW DISTRIBUTION/ SCALING LAWS/ TURBULENCE/ VORTICES/ WIND TUNNEL MODELS

ABA: GRA

ABS: A simplified Mach number scaling law is obtained for rotational and broadband noise components of a model helicopter rotor. The broadband noise sources are further classified into low frequency and high frequency components. The scaling laws are based on the geometric and performance parameters of the rotor and characteristics of the flow field. The existing theory of Lowson and Ollierhead is used deriving the conventional sixth power law for the rotational noise of geometrically similar blades operating in similar flow environments. The knowledge of unsteady aerodynamics was exploited to yield analytical formulation for the low frequency broadband radiation.

The ambiguous state of the art regarding the origin and nature of high frequency broadband noise does not permit such a straightforward scaling law for this frequency regime. Vortices are assumed to be shed at unknown Strouhal frequency and the scaling law is derived by simply integrating the blade sectional velocity over the span. The RIT 5 x 7-1/2 foot anechoic wind tunnel was used to perform experiments at controlled flow environ. Turbulence was generated at the inlet of the tunnel and simultaneous measurements of acoustic and turbulence signals were made. The experimentally obtained results are compared with the computed intensities and spectra of rotational noise, low frequency broadband noise and high frequency broadband noise from model rotors.

79N27125** ISSUE 18 PAGE 2362 CATEGORY 5 RPT#: NASA-CR-158778 TR-1441 CN#: HSG-2181 79/07/00
176 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/ CURTIS, H. C., JR.; B/KOMATSUZAI, T.; C/ TRAYBAR, J.D.
CORP: Princeton Univ., N.J., CSS: (Dept. of Mechanical and Aerospace Engineering) AVALIA. NTIS SAP: HC AO9/MF AO1

MAJS: / AERODYNAMIC STABILITY/ FEEDBACK/ HELICOPTERS/ TILTED PROPELLERS
MINS: / AERODYNAMIC STABILITY/ AUTOPILOT CONTROL/ DYNAMIC MODELS/ EQUATIONS OF MOTION/ FUSELAGES/ ROTARY WINGS/ TRANSFER FUNCTIONS

ABA: S.E.S.

ABS: The influence of single loop feedbacks to improve the stability of the system are considered. Reduced order dynamic models are employed where appropriate to promote physical insight. The influence of fuselage freedom on the aerelastic stability, and the influence of the airframe flexibility on the low frequency modes of motion relevant to the stability and control characteristics of the vehicle were examined.
considerations in designing a balance rig and a balance technique. The rotor was successfully balanced 9500 rpm. Uncontrollable coupling behavior prevented observations through the 16,000 rpm service speed. The balance technique is practical and with additional refinement it can meet production standards.

79n23919* ISSUE 15 PAGE 1926 CATEGORY 2 79/00/00 27 PAGES UNCLASSIFIED DOCUMENT
UTIL: Overview of helicopter ice protection system developments
AUTH: A. ADAMS, R. I.
CORP: Army Research and Technology Labs., Fort Eustis, Va. CS5: Applied Technology Lab. AVAIL NTIS SAP: HC 407/MF AO1
In NASA Lewis Res. Center Aircraft Icing p 39-65 (SEE N79-23812 15-02)
MAJS: /AIRCRAFT HAZARDS/H-HELICOPTERS/ICE FORMATION/TECHNOLOGY ASSESSMENT
MINS: /EQUIPMENT SPECIFICATIONS/ICE PREVENTION/ROTARY WINGS/THETA/DELECTRICITY
ABA: M.M.M.
ABS: Helicopter ice protection design criteria was developed and technological shortcoming in meeting helicopter mission requirements is that of helicopter rotor blade ice protection. Airframe components are protected using existing technology while the rotor blade protected using the cyclic electrothermal deicing concept.

79n25392* ISSUE 16 PAGE 2132 CATEGORY 37 79/02/00 45 PAGES UNCLASSIFIED DOCUMENT
UTIL: 1700 power turbine rotor multiplex/multispeed balancing demonstration
AUTH: A. BURGESS, G.; B/RI0. R.
CORP: Mechanical Technology, Inc., Latham, N. Y.
AVAIL NTIS SAP: HC 407/MF AO1
MAJS: /AERODYNAMIC BALANCE/ROTOR AERODYNAMICS/ROTOR SPEED TURBOSHAFTS/ VIBRATION DAMPING
MINS: CENTRIFUGAL FORCE/HELICOPTER CONTROL/ HIGH SPEED/LOW SPEED/PRODUCTION ENGINEERING
ABA: Author
ABS: Research was conducted to demonstrate the ability of influence coefficient based multispeed balancing to control rotor vibration through bending criticals. Rotor dynamic analyses were conducted of the General Electric 1700 power turbine rotor. The information was used to generate expected rotor behavior for optimal
developed that has six-degree-of-freedom capability. The mechanism was implemented on RSHA and its performance verified by ground and flight tests.

An investigation of two selected helicopter types, namely, the Models 206A/B and 212, is reported. An analysis of the available vibration and reliability data for these two helicopter types resulted in the selection of ten components located in five different areas of the helicopter and consisting primarily of instruments, electrical components, and other noncritical flight hardware. The potential for advanced technology in suppressing vibration in helicopters was assessed. The are still several unknowns concerning both the vibration environment and the reliability of helicopter non-critical flight components. Vibration data for the selected components were either insufficient or inappropriate. The maintenance data examined for the selected components were inappropriate due to variations in failure mode identification, inconsistent reporting, or inaccurate information.

The results of a study of the use of helicopters in agriculture and forestry in the United States are discussed. Comparisons with agricultural airplanes are made in terms of cost of aerial application to growers. An analysis of cost drivers and potential improvements to helicopters that will lower costs is presented. Future trends are discussed, and recommendations for research are outlined. Operational safety hazards and accident records are examined, and problem areas are identified. Areas where research and development are needed to provide opportunities for lowering costs while increasing productivity are analyzed.

The concept of a rotary-wing aircraft in general is defined. The energy effectiveness of helicopters is compared with that of other static thrust generators in hover, as well as with various air and ground vehicles in forward translation. The most important aspects of rotor-blade dynamics and rotor control are
reviewed. The simple, physically-mathematical model of the rotor offered by the momentum theory is introduced and its usefulness and limitations are assessed. The combined blade-element and momentum theory approach, which provides greater accuracy in performance predictions, is described as well as the vortex theory which models a rotor blade by means of a vortex filament or vorticity surface. The application of the velocity and acceleration potential theory to the determination of flow fields around three-dimensional, non-rotating bodies as well as to rotor aerodynamic problems is described. Airfoil sections suitable for rotors are also considered.

79N20103# ISSUE 11 PAGE 139 CATEGORY 5 RPT#: NASA-CH-152611 CNT#: NASA-7613 78/06/00 36 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/HONECKER, K. H.

CORP: Boeing Astronautics Corp., Seattle, Wash.

AVAIL.NTIS: SAP: HC 17A/NF AD

MAJS: /AIRCRAFT AERODYNAMICS/AIRCRAFT AIRCRAFT/ VIBRATION TESTS

MINS: /AERODYNAMICS/forces/ AERODYNAMICS/ DYNAMIC RESPONSE/ EXCITATION/ EXCITATION/ FINITE ELEMENT METHOD/ IMPEDANCE/ ROLLING MOMENTS/ ROLLING MOMENTS/ ROTOR BLADES (TORQUE/ALTIMETRY)

ABA: S.E.S.


The best technology program for a small, economically viable gas turbine engine applicable to the general aviation helicopter market was studied. Turboprop engines were designed for 1988 providing aircraft are designed to capitalize on the advantages of the turbine engine. Parametric engine families were defined in terms of design and off-design performance, mass, and cost. These were evaluated in aircraft design missions and selected to represent important market segments for fixed and rotary-wing applications. Payoff parameters influenced by engine cycle and configuration changes were aircraft gross mass, acquisition cost, total cost of ownership, and cash flow. Significant advantage over a current technology, small gas turbine engines was found especially in cost of ownership and fuel economy for airframes incorporating an air-cooled high-pressure ratio engine. A power class of 733 kW (1000 hp) was recommended as the next frontier for technology advance where large improvements in fuel economy and engine mass appear possible through component research and development.
A flexible mount is developed. The aerelastic rotor impedances are computed directly with a finite blade element method that includes aerodynamics. The rotor impedance matrix for three or more blades is determined from the root moment impedance for a single blade by a simple multiblade transformation rule. Force and moment amplitudes transferred from the rotor to support are found to be critically dependent on the support dynamics.

79N20606** ISSUE 11 PAGE 1375 CATEGORY B
78/00/00 15 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/DADONE, L.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS
SAP: HC A14/MF A01

MAJ: /*AERODYNAMIC STALLING/AIRFOILS/HELICOPTER PERFORMANCE/ROTOR WINGS
MINS: /*DYNAMIC CHARACTERISTICS/TRANSONIC FLOW/UNSTEADY STATE/WING OSCILLATIONS
ABA: Author

A significant amount of research was devoted to understanding the mechanism of dynamic stall delay as applicable to the flow environment of a helicopter rotor in forward flight. One aspect of such research deals with the unsteady characteristics of two-dimensional airfoil sections over a Mach number range from 0.3 to 9.6, since such characteristics can be meaningfully related to rotor performance and loads. This paper summarizes the results of several oscillatory tests carried out on conventional, transonic, and BLC-equipped airfoils.

79N17421** ISSUE 8 PAGE 1015 CATEGORY 47
78/03/00 12 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/ADAMS, R. I.
CORP: Army Research and Technology Labs., Fort Eustis, Va. AVAIL.NTIS
SAP: HC A12/MF A01

MAJ: /*HELICOPTERS/ICE FORMATION/PROTECTIVE COATINGS/RESEARCH
MINS: /*FLIGHT TESTS/PROTECTION/TABLES (DATA)/UH-1 HELICOPTER/V/STOL AIRCRAFT
ABA: G.Y.

A representative of the U.S. Army Research and Technology Laboratories was called upon to brief the workshop on results of flight test experiments with ice-phobic coatings applied to helicopter rotors. An overview of the Applied Technology Laboratory helicopter icing R and D program is presented.

79N15610** ISSUE 6 PAGE 772 CATEGORY 54
78/11/00 4 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/BARMES, J. A.
CORP: Human Engineering Labs., Aberdeen Proving Ground, Md. AVAIL.NTIS
SAP: HC A99/MF A01
In NASA, Langley Res. Center The 14th Ann. Conf. on Manual Control p 437-440 (SEE N79-15588 C5-54)

MAJ: /*EYE MOVEMENTS/FLIGHT CREWS/HELIC down/MEASURING INSTRUMENTS
MINS: /*HELICOPTERS/HUMAN FACTORS ENGINEERING/STRUCTURAL DESIGN/TELEVISION CAMERAS
ABA: L.S.

The helmet-mounted eye movement measuring system weighs 1.530 grams; the weight of the present aviator's helmet in standard form with the visor is
1,545 grams. The optical head is standard NAC
Eye-Werk. This optical head was mounted on a magnesium
yoke which in turn was attached to a slide cam mounted
on the flight helmet. The slide cam allows one to
adjust the eye-to-optics system distance quite easily
and to secure it so that the system will remain in
 calibration. The design of the yoke and slide cam is
such that the subject can, in an emergency, move the
optical head forward and upward to the stopped and
locked position atop the helmet. This feature was
necessary for flight safety. The television camera
that is used in the system is a solid-state General
Electric TN-2000 with a charged indium device imager
used as the vidicon.

79N15615# ISSUE 6 PAGE 771 CATEGORY 54
78/11/00 14 PAGES UNCLASSIFIED DOCUMENT

D/MEANAN, R. L.

CORP: Air Force Flight Dynamics Lab., Wright-Patterson AFB,
Ohio; Tactical Drone Squadron (11th), Davis-Montana
AFB, Az.; Crew Systems Consultants, Yellow Springs,
Ohio.

MAJS: /AIRCRAFT MANEUVERS/CH-47 HELICOPTER/DYNAMIC
CHARACTERISTICS/FLIGHT TESTS/INSTRUMENTATION
MINS: /AIRCRAFT CAPABILITY/COMPUTERIZED SIMULATION/
DATA ACQUISITION/FLIGHT TESTS/TERMINAL FACILITIES

ABA: G.Y.

ABS: The VTOl Approach and Landing Technology (VALT)
program is a significant experimental research program
aimed at establishing a data base for rotorcraft
operation in a terminal area environment. Work was
undertaken to determine helicopter math models
suitable for analyzing maneuvers along a VTOl
trajectory and to apply these math models to
determine the flight test procedures of greatest effectiveness
in establishing helicopter dynamic characteristics in
this mode of operation. As the principal result of
this investigation, a flight test specification is
presented for the CH-47 VALT aircraft operating along
the specified VTOl trajectory of the VALT program.

79N14079# ISSUE 5 PAGE 557 CATEGORY 5 RPT:
NASA-CR-150985 CNTR: NASA 014527 12/04/00 39 PAGES
UNCLASSIFIED DOCUMENT

AUTH: /POUERS, R. W.

CORP: Hughes Helicopters, Culver City, Calif. AVAIL.NTIS
SAP: HC 014385 A01

MAJS: /ADAPTIVE CONTROL/FEATHERING/HELICOPTERS/VELOCITY
BLADES/VELOCITY DAMPING

MINS: /HARMONIC OSCILLATION/PREDICTION ANALYSIS TECHNIQUES/
TRANSFER FUNCTION/VIBRATORY LOADS/WIND TUNNEL TESTS

ABA: G.G.

ABS: Higher harmonic blade feathering for helicopter
vibration reduction is considered. Recent wind tunnel
tests confirmed the effectiveness of higher harmonic
control in reducing articulated rotor vibratory hub
loads. Several predictive analyses developed in
support of the NASA program were shown to be capable
of calculating single harmonic control inputs required
to minimize a single 4P hub response. In addition, a
multiple-input, multiple-output harmonic control
predictive analysis was developed. All techniques
developed thus far obtain a solution by extracting
empirical transfer functions from sampled data.
Algorithm data sampling and processing requirements
are minimal to encourage adaptive control system application of such techniques in a flight environment.

79N13819# ISSUE 4 PAGE 520 CATEGORY 71 RPT#: NASA-CR-158973 CNT#: NAS1-14970 78/12/00 21 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/SEPHINERD, K. P.
CORP: Bionetics Corp., Hampton, Va. AVAIL. NTIS SAP: HC AO2/MF AOI
MAJS: /EFFECTIVE PERCEIVED NOISE LEVELS/HELICOPTER PROPELLER DRIVE/PROPELLER BLADES
MINS: /AIRCRAFT NOISE/ AUDITORY STIMULI/ HUMAN TOLERANCES/ NOISE INTENSITY
ABA: G.G.
ABS: The test stimuli recorded during a recent field study consisted of 16 sounds, each presented at 4 peak noise levels. Two helicopters and a fixed-wing aircraft were used. The impulsiveness characteristics of one helicopter were varied by operating at different rotor speeds, whereas the other helicopter, the noise of which was dominated by the tail rotor, displayed little variation in blade slap noise. Thirty-two subjects made noisiness judgments on a continuous, 11 point, numerical scale. Preliminary results indicate that proposed impulsiveness corrections provide no significant improvement in the helicopter's predictive ability of Effective Perceived Noise Levels (EPNL). For equal EPNL, the two categories of helicopter stimuli, one of which was far more impulsive than the other, showed no difference in judged noisiness.

Examination of the physical characteristics of the sounds presented in the laboratory highlighted the difficulty of reproducing acoustical signals with high crest factors.

79N10862# ISSUE 1 PAGE 114 CATEGORY 71 78/08/00 58 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/WITHE, R. P., JR.
CORP: Systems Research Labs., Inc., Dayton, Ohio. CSS: (RASA Div.) AVAIL. NTIS SAP: HC A19/MF AOI
MAJS: /AIRCRAFT NOISE/HELICOPTERS/ROTARY WINGS/ROTOR AERODYNAMICS/TECHNOLOGY ASSESSMENT
MINS: /AEROACOUSTICS/ NOISE REDUCTION/ TIP SPEED/ VIBRATION
ABA: J.M.S.
ABS: The problem of establishing the state of the technology is approached by first identifying the various characteristics of rotor noise and then assessing the state of technology in understanding and predicting the most important of these rotor noise characteristics in a real-world environment.

79N10861# ISSUE 1 PAGE 113 CATEGORY 71 78/08/00 28 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/MARZI, H. J.; B/DAMBRU. F.
CORP: Societe Nationale Industrielle Aerospatiale, Paris (France). AVAIL. NTIS SAP: HC A19/MF AOI
MAJS: /AIRCRAFT COMPARTMENTS/AIRCRAFT NOISE/HELICOPTERS/NOISE REDUCTION
MINS: /ENERGY ABSORPTION/GEARS/TRANSMISSIONS (MACHINE ELEMENTS)/ VIBRATION ISOLATORS
ABA: J.M.S.
ABS: Noise sources inside helicopter cabins are considered with emphasis on the mechanisms of vibration.
The influence of the noise environment on crew communications.

**AUTH:** A. LEVERTON, J. W.

**CORP:** Westland Helicopters Ltd., Yeovil (England).

**AVAIL:** NASA Langley Res. Center, Helicopter Acoustics, Pt. 2, p. 679-693 (SEE N79-10843 01-71)

**MAJUS:** /AIRCRAFT COMPARTMENTS/AIRCRAFT NOISE/ENVIRONMENTAL CONTROL/HOLES/VOICE COMMUNICATION

**MINS:** /ACOUSTIC ATTENUATION/HELMETS/MICROPHONES/NOISE REDUCTION/SIGNAL TO NOISE RATIOS

**ABA:** J. M. S.

**ABS:** The noise environment and how it affects crew communications in helicopters is considered. The signal to noise (S/N) ratio at the microphone and the effect of the attenuation provided by the helmet is discussed. This shows that the most important aspect is the S/N ratio at the microphone, particularly when helmets with improved attenuation characteristics are considered. Evidence is presented which shows that in high noise environments, the system S/N ratio is well below that required and hence there is an urgent need to reduce the cabin noise levels and improve the microphone rejection properties. Emphasis is placed on environmental/ acoustic considerations.
A practical approach to helicopter internal noise prediction

In NASA Langley Res. Center Helicopter Acoustics. Pt. 2 p 595-658 (SEE N79-10843 01-71)

A practical and well correlated procedure for predicting helicopter internal noise is presented. It accounts for the propagation of noise along multiple paths on an octave by octave basis. The method is sufficiently general to be applicable to conventional helicopters as well as other aircraft types, when the appropriate structural geometry, noise source strengths, and material acoustic properties are defined. A guide is provided for the prediction of various helicopter noise sources over a wide range of horsepower for use when measured data are not available. The method is applied to the prediction of the interior levels of the Civil Helicopter Research Aircraft (CHRRA) both with and without sound insulating installed. Results include good correlation with measured levels and prediction of the speech interference level within 1.5 dB at all conditions. A sample problem is also shown illustrating the use of the procedure. This example calculates the engine casing noise observed in the passenger cabin of the CHRRA.
In NASA. Langley Res. Center Helicopter Acoustics, Pt. 2 p 551-561 (SEE N79-10843 01-71)
MAJS: /*AIRCRAFT NOISE/HELOPTER DESIGN/*NOISE REDUCTION/* ROTARY WINGS
MINS: /* EFFECTIVE PERCEIVED NOISE LEVELS/ NOISE SPECTRA/ SPECTRAL SENSITIVITY/ THRUST/ TIP SPEED
ABA: J.M.S.
ABS: Results of the initial phase of a research project to study the design constraints on helicopter noise are presented. These include the calculation of noninsulative rotor harmonic and broadband hover noise spectra, over a wide range of rotor design variables and the sensitivity of perceived noise level (PNL) to changes in rotor design parameters. The prediction methodology used correlated well with measured whirl tower data. Application of the predictions to variations in rotor design showed tip speed and thrust as having the most effect on changing PNL.

79n10853*# ISSUE 1 PAGE 113 CATEGORY 71
78/08/00 6 PAGES UNCLASSIFIED DOCUMENT
UTTIL: An active noise reduction system for aircrew helmets
AUTH: A/WHEELER, P. D.; B/RAWINS, D.; C/PELC, S. F.; D/DORREY, T. P.
In NASA. Langley Res. Center Helicopter Acoustics, Pt. 2 p 545-550 (SEE N79-10843 01-71)
MAJS: /*ACOUSTIC ATTENUATION/*AIRCRAFT NOISE/*BIOACOUSTICS/* HELMETS/*NOISE REDUCTION
MINS: / FLIGHT SIMULATION/ HELICOPTERS/ ROTARY WINGS
ABA: J.M.S.
ABS: An active noise reduction system was developed for use in aircrew flying helmets in which the acoustic noise field inside the ear defender is detected using a miniature microphone and an antiphase signal is fed back to a communications telephone within the ear defender. Performance of the active noise reduction system in a laboratory trial simulating flight conditions is shown to be satisfactory.

79n10852*# ISSUE 1 PAGE 113 CATEGORY 71
78/08/00 10 PAGES UNCLASSIFIED DOCUMENT
UTTIL: A static acoustic signature system for the analysis of dynamic flight information
AUTH: A/LEB, D. J.
CORP: Army Armament Research. A/LEB, D. J. COMMAND, Aberdeen Proving Ground, Md. AVAIL.NTIS SAP: HC A19/MF A01
In NASA. Langley Res. Center Helicopter Acoustics, Pt. 2 p 535-544 (SEE N79-10843 01-71)
MAJS: /*AIRCRAFT NOISE/*MILITARY HELICOPTERS/*NOISE MEASUREMENT
MINS: / ANALYSIS (MATHEMATICAL)/ FLIGHT CHARACTERISTICS/ MICROPHONES/ POSITION (LOCATION)/ RANGING/ SOUN PROPAGATION
ABA: J.M.S.
ABS: The Army family of helicopters was analyzed to measure the polar octave band acoustic signature in various modes of flight. A static array of calibrated microphones was used to simultaneously acquire the signature and differential times required to mathematically position the aircraft in space. The signature was then reconstructed, mathematically normalized to a fixed radius around the aircraft.

79n10849*# ISSUE 1 PAGE 113 CATEGORY 71 CNT#: DAAJ01-74-C-1054 78/08/00 19 PAGES UNCLASSIFIED DOCUMENT
UTTIL: A method for determining internal noise criteria based on practical speech communication replied to helicopters
AUTH: A/STERNFELD, H., JR.; B/DOYLE, L. B.
In NASA. Langley Res. Center Helicopter Acoustics. Pt. 2 p 493-511 (SEE N79-10843 01-71)

MAJS: /AIRCRAFT COMPARTMENTS/ AIRCRAFT NOISE/ AUDITORY PERCEPTION/ HELICOPTERS/ SPEECH/ VOICE COMMUNICATION

MINS: /AUDITORY FATIGUE/ PSYCHOACOUSTICS/ STANDARDS

ABA: J.M.S.

ABS: The relationship between the internal noise environment of helicopters and the ability of personnel to understand commands and instructions was studied. A test program was conducted to relate speech intelligibility to a standard measurement called Articulation Index. An acoustical simulator was used to provide noise environments typical of Army helicopters. Speech material (command sentences and phonetically balanced word lists) were presented at several voice levels in each helicopter environment. Recommended helicopter internal noise criteria, based on speech communication, were derived and the effectiveness of hearing protection devices were evaluated.

79N10845# ISSUE 1 PAGE 112 CATEGORY 71
78/08/00 19 PAGES UNCLASSIFIED DOCUMENT

UTTL: Rating helicopter noise

AUTH: A/LEVERTICH, J. W.; B/SOUTHWOOD, B. J.; C/PIKE, A. C.
CORP: Westland Helicopters Ltd., Yeovil (England).
AVAIL.NTIS SAP: HC A17/99 MF A01
In NASA. Langley Res. Center Helicopter Acoustics. Pt. 2 p 419-438 (SEE N79-10843 01-71)

MAJS: /AIRCRAFT NOISE/ HELICOPTER TAIL ROTORS

MINS: /CORRECTION/ EFFECTIVE PERCEIVED NOISE LEVELS/ NOISE MEASUREMENT/ STATISTICAL CORRELATION

ABA: J.M.S.

ABS: The effectiveness of the EPNL procedure in quantifying helicopter blade slap and tail rotor noise heard on approach some distance from the flyover position is addressed. Alternative methods of rating helicopter noise are reviewed including correction procedures to the EPNL concept which account for blade slap and tail rotor noise. The impact of the use of such corrections is examined.

79N10844# ISSUE 1 PAGE 112 CATEGORY 71
78/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UTTL: Subjective evaluation of helicopter blade slap noise

AUTH: A/GALLOWAY, W. J.
AVAIL.NTIS SAP: HC A17/99 MF A01
In NASA. Langley Res. Center Helicopter Acoustics. Pt. 2 p 402-418 (SEE N79-10843 01-71)

MAJS: /AIRCRAFT NOISE/ HELICOPTERS/ ROTARY WINGS

MINS: /DIGITAL TECHNIQUES/ EFFECTIVE PERCEIVED NOISE LEVELS/ NOISE SPECTRA/ NOISE TOLERANCE/ SIGNATURE ANALYSIS/ SPECTRAL SIGNATURES

ABA: J.M.S.

ABS: Several methods for adjusting EPNL to account for its underestimate of judged annoyance are applied to eight helicopter flyover noise signatures having various degrees of blade slap. A proposal for an impulsive noise correlation procedure based on a digital analysis of the flyover signal is investigated. When all data are combined, the proposal is little better than simple adding an arbitrary fixed adjustment of 3 decibels to EPNL.

79N10453# ISSUE 1 PAGE 60 CATEGORY 39
78/10/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: Finite element analysis of helicopter structures

AUTH: A/RICH, M. J.
CORP: Sikorsky Aircraft, Stratford, Conn.
AVAIL.NTIS SAP: HC A10/99 MF A01
In NASA. Langley Res. Center Res. in Computerized Structural Analysis and Syn.: p 51-61 (SEE N79-10448

79N10452# ISSUE 1 PAGE 50 CATEGORY 39
78/10/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: Finite element analysis of helicopter structures

AUTH: A/RICH, M. J.
CORP: Sikorsky Aircraft, Stratford, Conn.
AVAIL.NTIS SAP: HC A10/99 MF A01
In NASA. Langley Res. Center Res. in Computerized Structural Analysis and Syn.: p 51-61 (SEE N79-10448

TERMINAL 20 PAGE 40 (ITEMS 148-151 OF 389)
VIBRATION

MINS: COMPUTER PROGRAMS/ COMPUTERIZED SIMULATION/ HELICOPTER ENGINES/ PROPULSION SYSTEM PERFORMANCE
ABA: B.B.

ABS: Vibration characteristics for overhauled T53 engines, including rejection rate, principal sources of vibration and normal procedures taken by the overhaul center to reduce engine vibration are summarized. Analytical and experimental data were compared to determine the engine's dynamic response to unbalance forces with results showing that the engine operates through bounding critical speeds. Present rigid rotor balancing techniques are incapable of compensating for the flexible rotor unbalance. A comparison of typical test cell and aircraft vibration levels disclosed significant differences in the engine's dynamic response. A probable spline shift phenomenon was uncovered and investigated. Action items to control costs and reduce vibration levels were identified from analytical and experimental studies.

78N33085# ISSUE 24 PAGE 3174 CATEGORY 5 RPT#: NASA-CR-151959 R-1393 CNT#: NAS2-7738 76/04/00 68 PAGES UNCLASSIFIED DOCUMENT
ULTL: Theoretical study of multicyclic control of a controllable twist rotor
AUTH: A/LEMMIO, A. Z.; B/DUHN, F. K.
CORP: Raman Aerospace Corp., Bloomfield, Conn. AVAIL.NTIS
SAP: HC AO/MF AO1

MAJS: /*CONTROL STABILITY/HELICOPTER DESIGN/ROTOR WINGS/ STRUCTURAL VIBRATION
MINS: /*AEROELASTICITY/ COMPUTER PROGRAMS/ FLAPS (CONTROL SURFACES)/ PITCH (INCLINATION)/ VIBRATION EFFECTS
ABA: Author

ABS: Analytical studies were performed to ascertain the feasibility of reducing helicopter rotor induced 4th harmonics vibratory forces by means of multicyclic flap control input on a dual control, four bladed rotor system. The dual control consisted of a primary inward pitch horn blade control and a secondary outboard flap control. Flap control was put in at frequencies greater than the rotor rotational speed.

78N32834# ISSUE 23 PAGE 3139 CATEGORY 71 CNT#: NSG-1474 78/08/00 13 PAGES UNCLASSIFIED DOCUMENT
ULTL: Bounding thickness and loading noise of rotating blades and the favorable effect of blade sweep on noise reduction
AUTH: A/FARASSAT, F.; B/NYSTROM, P. A.; C/BROWN, T. J.
PAA: C/(AVRACOM Res. and Technol. Labs.)
CORP: George Washington Univ., Washington, D. C. CSS: 1

01-39
MAJS: /*COMPUTERIZED SIMULATION/ DYNAMIC STRUCTURAL ANALYSIS
/*FINITE ELEMENT METHOD/ HELICOPTERS
MINS: /*AIRFRAMES/ COMPONENTS/ COMPOSITE STRUCTURES
ABA: G.G.

ABS: Application of the finite element analysis is now being expanded to three dimensional analysis of mechanical components. Examples are presented for airframe, mechanical components, and composite structure calculations. Data are detailed on the increase of model size, computer usage, and the effect on reducing stress analysis costs. Future applications for use of finite element analysis for helicopter structures are projected.

79N10423# ISSUE 1 PAGE 57 CATEGORY 37 RPT#: NASA-CR-135372 LCC-77-65 CNT#: NAS5-20045 77/10/00 41 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/BRJEN, M.
CORP: Avco Lycoming Div., Stratford, Conn. AVAIL.NTIS
SAP: HC AO/MF AO1
Sponsored in part by USAAMRDC

MAJS: /*FLUID TRANSMISSION LINES/ *LEAKAGE/ *SEALS (STOPPERS)
MINS: /*ELASTOMERS/ HELICOPTERS/ LUBRICATION SYSTEMS/ OILS/ RETAINING/ SEALING
ABA: Author

ABS: An experimental evaluation was performed on a high-speed (72.9 m/s, 14,349 ft/min) transmission seal of the synergetic type. During testing of the seal, oil leakage occurred at positive bearing cavity pressures. Modifications were made in an attempt to eliminate the leakage but none were completely successful. Leakage appears to be the result of questionable positioning of the sealing elements resulting in inadequate shaft contact by the oil side sealing element. This condition may be related to the nonsymmetrical shape of the elastomeric retainer and to dimensional changes caused by swelling of the elastomeric retainer from exposure to the sealed fluid. Indications of a speed dependent leakage characteristic were also observed.

79N10661# ISSUE 1 PAGE 9 CATEGORY 7 RPT#: NASA-CR-135449 MTI-78TR66 CNT#: NAS5-20609 78/11/00 60 PAGES UNCLASSIFIED DOCUMENT
ULTL: Study of T53 engine vibration TLSP: Final Report
AUTH: A/WALTER, T. J.
CORP: Mechanical Technology, Inc., Latham, N. Y. AVAIL.NTIS SAP: HC AO/MF AO1

MAJS: /*DYNAMIC RESPONSE/ /*GAS TURBINE ENGINES/ /*T-53 ENGINE/
Joint Inst. for Advancement of Flight Sciences.)

Available. NTIS. SAP: HC A17/MF A01
In NASA. Langley Res. Center. Helicopter Acoustics p 371-385 (See N78-32816 23-71) Supported in part by
AROC.

MAJS: /AIRCRAFT NOISE/HELIICOPTERS/NOISE REDUCTION/ROTOR WINGS/
SHEEP EFFECT/THICKNESS RATIO/WING LOADING

MINS: /AEROCOUSTICS/AIRFOIL PROFILES/NOISE POLLUTION/
POLLUTION CONTROL

ABA: J.M.S.

ABS: The maxima of amplitudes of thickness and loading noise harmonics are established when the radial distribution

of blade chord, thickness ratio, and lift coefficient is specified. It is first shown that only airfoils with thickness
distribution and chordwise loading distributions which are symmetric with respect to midchord need be considered for finding

the absolute maxima of thickness and loading noise. The resulting chordwise thickness and load distributions for these

maximum noise conditions require infinite slope at some points along the chord but otherwise are uniform. It is shown that

sweeping the blades reduces the thickness and loading noise, but there is no optimum sweep which generates the lowest

do

dimensional airfoil theories valid in the subsonic, transonic, and supersonic speed ranges. For nonlifting parabolic arc blades, the two sources are equally

important at speeds between the section critical Mach number and a Mach number of one. However, for

moderately subsonic or fully supersonic flow over thin blade sections, the quadrupole term is negligible. It

is concluded for thin blades that significant quadrupole noise radiation is strictly a transonic phenomenon and that it can be

suppressed with blade sweep. Noise calculations are presented for two rotors, one simulating a helicopter main rotor and the

other a model propeller. For the latter, agreement with test data was substantially improved by including the

quadrupole source term.

78N32832# ISSUE 23 PAGE 313B CATEGORY 71
78/08/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Improved methods for calculating the thickness noise

AUTH: A/NAKAMURA. Y.: B/AZUMA. A.

CORP: Tokyo Univ. (Japan). AVAL.NTIS. SAP: HC A17/MF A01

In NASA. Langley Res. Center. Helicopter Acoustics p 322-327 (See N78-32816 23-71)

MAJS: /AIRCRAFT NOISE/HELIICOPTERS/PREDICTION ANALYSIS

MINS: /THICKNESSES/ROTOR WINGS

ABA: J.M.S.

ABSTRACT: Advanced methods to compute the rotor thickness noise which is predominant in the case of high speed rotor

were developed. These methods were deduced from a previous method by transforming the integral

coordinate, commuting the order of integration and differential, and/or performing chordwise integration analytically with some adequate assumption. The

necessary computational times and waveforms obtained by the previous and three advanced methods were compared. It was then concluded that the advanced

methods could save the computational time compared with the previous method with the same accuracy.

78N32820# ISSUE 23 PAGE 313B CATEGORY 71
78/08/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTL: Helicopter external noise prediction and correlation with flight

AUTH: A/GUPTA. B. P.

CORP: Textron Bell Helicopter. Fort Worth. Tex.

AVA1N.TIS. SAP: HC A17/MF A01

In NASA. Langley Res. Center. Helicopter Acoustics p 263-275 (See N78-32816 23-71)

MAJS: /AIRCRAFT NOISE/HELIICOPTERS/PREDICTION ANALYSIS

TERMINAL 20 PAGE 42 (ITEMS 156-158 OF 309)
**TECHNIQUES/ROTARY WINGS**

**MINS:** /AERODYNAMIC LOADS/ FLIGHT TESTS/ NOISE POLLUTION/ NOISE REDUCTION/ PERFORMANCE PREDICTION/ POLLUTION CONTROL

**ABA:** J.M.S.

**ABS:** Mathematical analysis procedures for predicting the main and tail rotor rotational and broadband noise are presented. The aerodynamic and acoustical data from Operational Loads Survey (OLS) flight programs are used for validating the analysis and noise prediction methodology. For the long method of rotational noise prediction, the spanwise, chordwise, and azimuthwise airloading is used. In the short method, the airloads are assumed to be concentrated at a single spanwise station and for higher harmonics an airloading harmonic exponent of 2.0 is assumed. For the same flight condition, the predictions from long and short methods of rotational noise prediction are compared with the flight test results. The short method correlates as well or better than the long method.

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**78N32825#** ISSUE 23 PAGE 3138 CATEGORY 71

**CMT#:** DAAG29-76-C-0027 78/08/00 41 PAGES UNCLASSIFIED DOCUMENT

**UTTL:** Wind tunnel investigations of model rotor noise at low speed

**AUTH:** A./ARAYAMUDAN, K. S.; B./LEE, A.; C./HARRIS, W. L.

**CORP:** Massachusetts Inst. of Tech. Cambridge. AVAIL NTIS SAP: HC A17/MF A01

In NASA, Langley Res. Center Helicopter Acoustics p 221-261 (SEE N78-32816 23-71)

**MAJS:** /AIRCRAFT NOISE/Helicoter Acoustics/Low Speed/ROTARY WINGS/TIP SPEED/WIND TUNNEL TESTS

**INS:** /AEROCOUSTICS/AIRCRAFT PERFORMANCE/ NOISE POLLUTION/ NOISE REDUCTION/ POLLUTION CONTROL/ TURBULENCE

**ABA:** J.M.S.

**ABS:** Experimental and related analytical results on model rotor rotational and broadband noise obtained in the anechoic wind tunnel and rotor facility are summarized. Factors studied include various noise sources, effects of helicopter performance parameters on noise generated by a model main rotor, appropriate scaling laws for the various types of main rotor noise, and the effects of intensity and size scales of injected turbulence on the intensity and spectra of broadband noise.

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**78N32824#** ISSUE 23 PAGE 3137 CATEGORY 71

**78/08/00 21 PAGES UNCLASSIFIED DOCUMENT

**UTTL:** Theory on acoustic sources

**AUTH:** A./WRIGHT, S. E.

**CORP:** Stanford-Univ., Calif. AVAIL NTIS SAP: HC A17/MF A01

In NASA, Langley Res. Center Helicopter Acoustics p 127-147 (SEE N78-32816 23-71) Sponsored by ONERA

**MAJS:** /AEROCOUSTICS/AIRCRAFT NOISE/Helicoter Noise PROPAGATION/ROTARY WINGS

**INS:** /NOISE SPECTRA/ PREDICTION ANALYSIS TECHNIQUES/ RADIATION SPECTRA

**ABA:** J.M.S.

**ABS:** A theory is described for the radiation emission from acoustic multipole sources. The sources
can be stationary or moving at speeds including supersonic and experience stationary or moving disturbances. The effect of finite source disturbances and disturbances is investigated as well as the manner in which they interact. Distinction is made between source distributions that responded as a function of time and those that respond as a function of space.

78N32802*# ISSUE 23 PAGE 3137 CATEGORY 71
78/08/00 18 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/SMITH, R. K.
CORP: United Technologies Research Center, East Hartford, Conn. AVAIL NTIS SAP: HC A17/1F A01
In NASA. Langley Res. Center Helicopter Acoustics p 109-126 (SEE N78-32816 23-71)

MAJS: /AIRCRAFT NOISE/HELICOPTERS/NOISE GENERATORS/NOISE POLLUTION/NOTARY WINGS/TURBULENCE

MINS: /HOVERING/NOISE REDUCTION/NOISE SPECTRA/POLLUTION CONTROL/PREDICTION ANALYSIS TECHNIQUES/PROPELLER BLADES

ABA: J.M.S.

ABS: A procedure for calculating the noise due to turbulent inflow to a propeller or helicopter rotor in hover is summarized. The method is based on a calculation of noise produced by an airfoil moving in rectilinear motion through turbulence. At high frequency the predicted spectrum is broadband, while at low frequency the spectrum is peaked around multiples of blade passage frequency. The results of a parametric study of the variation of the noise with rotor tip speed, blade number, chord, turbulence scale, and directivity angle are given. A comparison of the theory with preliminary experimental measurements shows good agreement.

78N32820*# ISSUE 23 PAGE 3137 CATEGORY 71
78/08/00 20 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/HAWKINGS, D. L.
CORP: Westland Helicopters Ltd., Hayes (England). AVAIL NTIS SAP: HC A17/1F A01
In NASA. Langley Res. Center Helicopter Acoustics p 89-108 (SEE N78-32816 23-71)

MAJS: /AIRCRAFT NOISE/HELICOPTERS/NOISE POLLUTION/POLLUTION CONTROL/PREDICTION ANALYSIS TECHNIQUES/NOTARY WINGS

MINS: /HIGH SPEED/LOW SPEED/NOISE INTENSITY/NOISE REDUCTION

ABA: J.M.S.

ABS: The interrelationship of urban helicopter operations, helicopter noise, and the establishment of urban public-use heliports is discussed. Public resistance to urban helicopter operations due to concerns for safety and noise is shown to negatively impact the establishment of public-use heliports in urban areas. These are indicated that increased government and industry effort to reduce helicopter noise is needed to reduce continued growth in the helicopter industry.
78N32819# ISSUE 23 PAGE 3137 CATEGORY 71
78/08/00 12 PAGES UNCLASSIFIED DOCUMENT

UTIL: Noise requirements from a military point of view
AUTH: A/CRAWFORD, C. C., JR.
CORP: Army Aviation Research and Development Command, St.
Louis, Mo. AVAIL.NTIS SAP: HC A17/MF A01
In NASA: Langley Res. Center Helicopter Acoustics p
44 (SEE N78-32816 23-71)
MAJS: /*AIRCRAFT NOISE/*MILITARY HELICOPTERS/*NOISE
POLLUTION/*POLLUTION CONTROL
MINS: /AIRCRAFT PERFORMANCE/COST EFFECTIVENESS/HELICOPTER
DESIGN/NOISE REDUCTION/STANDARDS
ABA: J.M.S.

ABS: External and internal aircraft noise requirements are
discussed in terms of application to military
helicopters. The impact of the application of noise
reduction technology to comply with FAA standards on
cost and performance is emphasized.

78N32818# ISSUE 23 PAGE 3136 CATEGORY 71
78/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UTIL: Helicopter noise regulations: An industry perspective
AUTH: A/WAGNER, R. A.
CORP: Helicopter Association of America, Washington, D. C.
AVAIL NTIS SAP: HC A17/MF A01
In NASA: Langley Res. Center Helicopter Acoustics p
22 (SEE N78-32816 23-71)
MAJS: /*AIRCRAFT NOISE/*HELICOPTERS/*NOISE POLLUTION/*
POLLUTION CONTROL
MINS: /AIRCRAFT INDUSTRY/GOVERNMENT/INDUSTRY RELATIONS/
NOISE REDUCTION/REGULATIONS/STANDARDS/TECHNOLOGY
ASSESSMENT
ABA: J.M.S.

ABS: A review of helicopter noise measurement programs and
noise reduction/economic studies of FAA is given along
with a critique of a study which addresses the
economic impact of noise reduction on helicopter
noise. Modification of several helicopters to reduce
noise and demonstrate the economic impact of the
application of the current state-of-the-art technology
is discussed. Specific helicopters described include
Boeing Vertol 347 Helicopter, Hughes OH-6 Helicopter,
and Hughes 269C Helicopter. Other topics covered
include: (1) noise trends and possible noise limits;
(2) accuracy of helicopter noise prediction
techniques; (3) limited change possibilities of
derivatives: and (4) rotor impulse noise. The unique
operational capabilities of helicopters and the
implications relative to noise regulations and
certification are discussed.

78N32466# ISSUE 23 PAGE 3092 CATEGORY 39
78/10/06 20 PAGES UNCLASSIFIED DOCUMENT

UTIL: Dynamic analysis using super elements for a large
helicopter model
AUTH: A/PATEL, M. P.; B/SHEH, L. C. PAA: B/(Multiple
Access Inc.)
CORP: Hughes Helicopters, Culver City, Calif. AVAIL NTIS
SAP: HC 24/0F A01
In NASA: Marshall Space Flight Center Seventh
NASTRAN user’s Colloq. p 335-354 (SEE N78-32466 23-39)
MAJS: /*AIRCRAFT MODELS/*DYNAMIC STRUCTURAL ANALYSIS/*
HELICOPTERS
MINS: /NASTRAN/STRESS ANALYSIS/SUBSTRUCTURES
ABA: J.A.M.

ABS: Using super elements (substructures), modal and
frequency response analysis was performed for a large
model of the Advanced Attack Helicopter developed for
the U.S. Army. Whittletree concept was employed so
that the residual structure along with the various
super elements could be represented as beam-like
structures for economical and accurate dynamic

TERMINAL 20 PAGE 45 (ITEMS 166-169 OF 389)
analysis. A very large NSAP alter to the rigid format was developed so that the modal analysis, the frequency response, and the strain energy in each component could be computed in the same run.

78N30139# ISSUE 21 PAGE 2762 CATEGORY B RPT#: NASA-CR-158909 CNT#: NSG-1114 78/07/00 55 PAGES UNCLASSIFIED DOCUMENT

UTLTI: Structural dynamics, stability, and control of helicopters

AUTH: A/HELEOIVITCH, L.; B/HALE, A. L.

CORP: Virginia Polytechnic Inst. and State Univ., Blacksburg. AVAIL.NTIS SAP: HC AO4/MF AO1

MAJS: /DYNAMIC STRUCTURAL ANALYSIS/HELICOPTERS/

MINS: /ANALYSIS (MATHEMATICS)/COMPUTER PROGRAMS/

ABS: For abstract, see N70-30042.

78N30043# ISSUE 21 PAGE 2749 CATEGORY 2 RPT#: NASA-CR-145323 LR-28435-VOL-2 CNT#: NASI-14570 78/06/00 3 VOLS 177 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/REASE, J. S.; B/KRETSINGER, P. H.

CORP: Lockheed-California Co., Burbank. AVAIL.NTIS SAP: HC AO4/MF AO1

Sponsored in part by Avradcom

MAJS: /AERIALS/COMPUTER PROGRAMS/COMPUTERIZED SIMULATION

MINS: /EQUATIONS OF MOTION/ROTORCRAFT AIRCRAFT

ABS: For abstract, see N70-30042.

78N30045# ISSUE 21 PAGE 2749 CATEGORY 2 RPT#: NASA-CR-145331 LR-28435-VOL-1 CNT#: NASI-1457C 78/06/00 3 VOLS 272 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/REASE, J. S.; B/KRETSINGER, P. H.

CORP: Lockheed-California Co., Burbank. AVAIL.NTIS SAP: HC AO4/MF AO1

Sponsored in part by AVRADCOM

MAJS: /AERIALS/COMPUTER PROGRAMS/COMPUTERIZED SIMULATION

MINS: /ROTORCRAFT AIRCRAFT

ABS: For abstract, see N70-30042.

78N29063# ISSUE 20 PAGE 2622 CATEGORY 5 RPT#: NASA-CR-145377 D210-11278-1 CNT#: NASL-13524 78/08/00 52 PAGES UNCLASSIFIED DOCUMENT

UTLTI: Civil helicopter design and operation requirement TSLP; Final Technical Report

AUTH: A/WATERS, K. T.


Sponsored in part by Avradcom

MAJS: /AIRCRAFT INDUSTRY/CIVIL AVIATION/HELICOPTER DESIGN

MINS: /AIRCRAFT SAFETY/COST REDUCTION/OPERATING COSTS/HELIPOPTER PERFORMANCE/LAND USE/LIFE CYCLE COSTS/MILITARY HELICOPTERS

ABS: For abstract, see N78-30042.
ABA: A. R. H.

ABS: Design and operational requirements and other factors that have a restraining influence on expansion of the helicopter market are discussed. The needs of operators, users, pilots and the community at large are examined. The impact of future technology developments and other trends such as use, energy shortages, and civil and military helicopter requirements and development is assessed. Areas where research and development are needed to provide opportunities for lowering life cycle costs and removing barriers to further expansion of the industry are analyzed.

78N29682* ISSUE 20 PAGE 2222 CATEGORY 5 RPT#: NASA-CR-156738 CNT#: NAS1-13624 76/08/00 58 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Research requirements to reduce civil helicopter life cycle cost

AUTH: A/ BLEWITT, S. J.


MAJS: / "AIRCRAFT INDUSTRY/ "CIVIL AVIATION/ "COST REDUCTION/ "HELICOPTERS/ "LIFE CYCLE COSTS/ "RESEARCH AND DEVELOPMENT

MINS: / MAINTENANCE/ PASSENGER AIRCRAFT/ PRODUCTION ENGINEERING/ PRODUCTION MANAGEMENT/ RELIABILITY ENGINEERING

ABA: A. R. H.

ABS: The problem of the high cost of helicopter development, production, operation, and maintenance is defined and the cost drivers are identified. Helicopter life cycle costs would decrease by about 17 percent if currently available technology were applied. With advanced technology, a reduction of about 30 percent in helicopter life cycle costs is projected. Technological and managerial deficiencies which contribute to high costs are examined, basic research and development projects which can reduce costs include methods for reduced fuel consumption, improved turbine engine design and advanced production methods: safety: rotor systems: and advanced transmission systems.

78N27401# ISSUE 18 PAGE 2396 CATEGORY 37 RPT#: NASA-CR-135195 SKF-GL71021 CNT#: NAS1-17343 78/01/00 125 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/ROSENLEIB, J. W.

CORP: SKF Industries, Inc., King of Prussia, Pa. CSS: (Research Lab.) AVAIL NTIS SAP: HC AO5/MF AO1

Majs: / "AIR COOLING/ "BEARINGS/ "HELICOPTERS/ "LUBRICATION

MINS: / COOLING SYSTEMS/ "LUBRICATING OILS/ "LUBRICATION SYSTEMS/ "MIST/ "SYSTEMS ENGINEERING

ABA: Author

ABS: An analysis and system study was performed to provide design information regarding lubricant and coolant flow rates and flow paths for effective utilization of the lubricant and coolant in a once-through oil-mist (microflow) and coolant air system. A system was designed, manufactured, coupled with an existing rig and evaluation tests were performed using 46 mm bore split-inner angular contact ball bearings under 1775N (400 lb.) thrust load. An emergency lubrication aspiration system was also manufactured and tested under lost lubricant conditions. The testing demonstrated the feasibility of using a mist oil and cooling air system to lubricate and cool a high speed helicopter engine mainshaft bearing. The testing also demonstrated the feasibility of using an emergency aspiration lubrication system as a viable survivability concept for helicopter mainshaft engine bearing for periods as long as 30 minutes.

78N25832# ISSUE 16 PAGE 274 CATEGORY 71 RPT#: NASA-CR-152150 MIT-78-9 CNT#: HGO-2142 79/01/00 59 PAGES UNCLASSIFIED DOCUMENT

UTTIL: The effect of tip vortex structure on helicopter noise due to blade/vortex interaction

AUTH: A/ WOLF, T. L.; B/WINDALL, S. E.

CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Fluid Dynamics Research Lab.) AVAIL NTIS SAP: HC AO5/MF AO1

Majs: / "AERODYNAMIC NOISE/ "BLADE TIPS/ "HELICOPTERS/ "NOISE MEASUREMENT/ "ROTARY WINGS/ "VORTEXES

MINS: / GAS-SOLID INTERFACES/ "ROTOR LIFT/ "UNSTEADY FLOW/ "VELOCITY DISTRIBUTION

ABA: Author

ABS: A potential cause of helicopter impulsive noise, commonly called blade slap, is the unsteady lift fluctuation on a rotor blade due to interaction with the vortex trailed from another blade. The relationship between vortex structure and the intensity of the acoustic signal is investigated. The analysis is based on a theoretical model for blade/vortex interaction. Unsteady lift on the blades due to blade/vortex interaction is calculated using linear unsteady aerodynamic theory. and expressions are derived for the directivity, frequency spectrum, and transient signal of the radiated noise. An inviscid roll-up model is used to calculate the velocity profile in the trailing vortex from the spanwise distribution of blade tip loading. A few
cases of tip loading are investigated, and numerical results are presented for the unsteady lift and acoustic signal due to blade/vortex interaction. The intensity of the acoustic signal is shown to be quite sensitive to changes in tip vortex structure.

ABA: Author

ABS: A program was conducted in which 25 test subjects adjusted the levels of various helicopter rotor spectra until the combination of the harmonic noise and a broadband background noise was judged equally annoying as a higher level of the same broadband noise spectrum. The subjective measure of added harmonic noise was equated to the difference in the two levels of broadband noise. The test participants also made subjective evaluations of the rotor noise signatures which they created. The test stimuli consisted of three degrees of rotor impulsiveness, each presented at four blade passage rates. Each of these 12 harmonic sounds was combined with three broadband spectra and was adjusted to match the annoyance of three different sound pressure levels of broadband noise. Analysis of variance indicated that the important variables were level and impulsiveness. Regression analyses indicated that inclusion of crest factor improved correlation between the subjective measures and various objective or physical measures.

ABA: Author

ABS: The applicability of a once-through oil mist system to the lubrication of helicopter spur gears was investigated and compared to conventional jet spray lubrication. In the mist lubrication mode, cooling air was supplied at 366K (200 F) to the out of mesh location of the gear sets. The mist air was also supplied at 366K (200 F) to the radial position mist nozzle at a constant rate of 0.0632 mol/s (3 SCFM) per nozzle. The lubricant contained in the mist air varied between 32 - 40%. In the recirculating jet spray mode, the flow rate was varied from 1000 to 2650 cc/hour. Visual inspection revealed the jet spray mode produced a superior surface finish on the gear teeth but a thermal energy survey showed a 15 - 20% increase in heat generated. The gear tooth condition in the mist lubrication mode system could be improved if the cooling air and lubricant/air flow ratio were increased. The test gearbox and the procedure used are described.
The system design, dispersion data developed through analysis and the 1919B digital computer program are verified and refined using the fixed-base, man-in-the-loop XV-15 VSTOLAND simulation.

AUTH: A/BORN, G. J.; B/KAT, T.
CORP: Princeton Univ., N. J.
CSS: [Instrumentation and Control Lab.]
MAJS: /APPLICATION CONTROl/*CONTROL THEORY/*HELICOPTERS/* POVERING STABILITY
MINS: / DAMPING/ FEEDBACK CONTROL/ GROUND EFFECT MACHINES/ LINEAR EQUATIONS/ WEIGHT (MASS)

A major difficulty in the practical application of linear-quadratic regulator theory is how to choose the weighting matrices in quadratic cost functions. The control system design with optimal weighting matrices was applied to a helicopter in the hover and approach phase. The weighting matrices were calculated to extramize the closed loop total system damping subject to constraints on the determinants. The extremization is really a minimization of the effects of disturbances, interpreted as a compromise between the generalized system accuracy and the generalized system response speed. The trade-off between the accuracy and the response speed is adjusted by a single parameter, the ratio of determinants. By this approach, an objective measure can be obtained for the design of a control system. The measure is to be determined by the system requirements.

AUTH: A/DOUGHERTY, J. J.; III; E/BRATIHI, L. D.

MINS: /AIRCRAFT RELIABILITY/*HELICOPTERS/*TECHNOLOGY ASSESSMENT

The major reliability problems of the civil helicopter fleet as reported by helicopter operational and maintenance personnel are documented. An assessment of each problem is made to determine if the reliability can be improved by application of present technology or whether additional research and development are required. The reliability impact is measured in three ways: (1) the relative frequency of each problem in the fleet; (2) the relative on-aircraft manhours to repair, associated with each fleet problem; (3) the relative cost of repair materials or replacement parts associated with each fleet problem. The data reviewed covered the period of 1971 through 1976 and covered only helicopter engine aircraft.

AUTH: A/BRENIER, J. S.
CORP: Lockheed-California Co., Burbank.

MINS: /AIRCRAFT MODELS/*CONTROL SIMULATION/*ROTARY WING AIRCRAFT/*ROTOR AERODYNAMICS/*USER MANUALS (COMPUTER PROGRAMS)

ABS: For abstract, see N78-2037.

AUTH: A/BRENIER, J. S.; S/SAIKI, D. M.
CORP: Lockheed-California Co., Burbank.

MINS: /CDC COMPUTERS/*FLOW CHARTS/*IBM 360 COMPUTER/*INPUT/OUTPUT ROUTINES/*SUBROUTINES

ABS: A computer program used to process the equations is presented, and a full description of equation implementation is given. The model was implemented in the IBM 360 and CDC series computer systems.

AUTH: A/BRENIER, J. S.; S/SAIKI, D. M.
CORP: Lockheed-California Co., Burbank.

MINS: /CDC COMPUTERS/*FLOW CHARTS/*IBM 360 COMPUTER/*INPUT/OUTPUT ROUTINES/*SUBROUTINES

ABS: For abstract, see N78-2037.

AUTH: A/BRENIER, J. S.; S/SAIKI, D. M.
CORP: Lockheed-California Co., Burbank.

MINS: /IBM 360 COMPUTER/*CDC COMPUTERS/*FLOW CHARTS/*INPUT/OUTPUT ROUTINES/*SUBROUTINES

ABS: A computer program used to process the equations is presented, and a full description of equation implementation is given. The model was implemented in the IBM 360 and CDC series computer systems.
A method for parametric variations in drive train dynamic analysis is described. The method models the individual components of a drive system. The appropriate system interface coordinates and calculates the system dynamic response at particular frequencies. Application of the method for prediction of the dynamic response characteristics of a helicopter transmission, and a comparison of results with test data are also included.


Approach and landing guidance sensors essential to recover VSTOL aircraft and helicopter on ships are described. Alternative techniques which feature different operating frequencies from microwave to optical-infrared, different geometric techniques of position fixing by range and angle measurements from a single point or points on a short baseline available at the landing platform typically forty feet wide are included. Other factors discussed include ceiling/visibility requirements, close approach, safety and precision acceptance, and compatibility with VSTOL aircraft and VSTOL.
A new seal concept, the negative lift circumferential type seal, was evaluated under simulated helicopter transmission conditions. The bore of the circumferential seal contains stepped geometry which produces a negative lift that urges the sealing segments towards the shaft surface. The seal size was a 2.5 inch bore and the test speeds were 7000 and 14,250 rpm. During the 300 hour test at typical transmission seal pressure (to 2 psig) the leakage was within acceptable limits and generally less than 0.1 cc/hour during the last 150 hours of testing. The wear to the carbon segments during the 300 hours was negligible.

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A two-dimensional wind tunnel test was conducted to obtain the quasi-steady and unsteady characteristics of an advanced airfoil designed for helicopter rotor applications. Differential pressures were measured at 17 locations along the chord of the airfoil model. The airfoil motions were sinusoidal forced-pitch oscillations about the quarter chord at amplitudes varying from 2.5 to 10.0 degrees and at frequencies from 23 Hz to 90 Hz. The quasi-steady tests were conducted at Mach numbers from 0.2 to 0.9 and the oscillatory tests between M = 0.2 and M = 0.7. At quasi-steady conditions a limited number of drag measurements were made with a wake traversing probe.
The problem was studied and resolved. The pressure distribution, lift, and pitching moment were obtained for an XV-15 wing-fuselage-tail rotor configuration at various flight conditions. For the flight configurations explored, the effects of the rotor wake interference on the XV-15 tilt rotor aircraft yielded a reduction in the total lift and an increase in the nose-down pitching moment. This method provides an analytical capability that is simple to apply and can be used to investigate fuselage-tail rotor wake interference as well as to explore other rotor design problem areas.

78N12472* ISSUE 3 PAGE 349 CATEGORY 39 77/GO/00 20 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/PANDI, P. R.; B/GHAMITE, J. D. PAA: B/(Bell) Helicopter Textron

CORP: Computer Sciences Corp., Hampton, Va. AVAIL.NTIS SAP: HC A20/0/0 A01
In NASA, Washington Sixth NASRAN Users Colloq. 449-468 (SEE N78-12445 03-39)

SUBJ: /COMPUTER PROGRAMS/ NASRAN/ RIGID STRUCTURES

MINS: /DATA PROCESSING/ HELICOPTERS/ INFORMATION SYSTEMS/ STRUCTURAL ANALYSIS

ABA: Author

ABS: Four rigid elements, namely, a rigid rod element (CRIGCR) and three rigid body elements (CRIGD, CRIGD2 and CRIGD3), have recently been added to NASRAN and will be available in the next public release of the program. The theoretical formulation, the bulk data information and the programming details pertaining and realistic problems are illustrated by employing them in the solution of two helicopter structural analysis problems.

78N11519* ISSUE 2 PAGE 215 CATEGORY 45 RPT#: NASA-CR-145238 CNT#: NGS-1121 77/08/00 62 PAGES UNCLASSIFIED DOCUMENT


SUBJ: /CIVIL AVIATION/ ECONOMICS/ ENVIRONMENTAL SURVEYS/ HELICOPTERS

MINS: /ECONOMIC FACTORS/ GOVERNMENTS/ MODELS

ABA: Author

ABS: The technical, economic, and environmental problems restricting commercial helicopter passenger operations are reviewed. The key considerations for effective assessment procedures are outlined and a preliminary model for the environmental analysis of helicopters is developed. It is recommended that this model, or some similar approach, be used as a common base for the development of comprehensive environmental assessment methods for each of the federal agencies concerned with helicopters. A description of the critical environmental research issues applicable to helicopters is also presented.

78N10117* ISSUE 1 PAGE 18 CATEGORY 9 RPT#: NASA-CR-152666 TR-1057-1 CNT#: NAS2-9421 77/09/00 59 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/SINACORI, J. B.

CORP: Systers Technology, Inc., Mountain View, Calif. AVAIL.NTIS SAP: HC A04/0/0 A01

SUBJ: /FLIGHT SIMULATION/ HELICOPTERS/ SYSTEMS ENGINEERING

MINS: /AERODYNAMICS/ RESEARCH FACILITIES/ RESEARCH MANAGEMENT

ABA: Author

ABS: Important requirements were defined for a flight simulation facility to support Army helicopter development. In particular, requirements associated with the visual and motion subsystems of the planned simulator were studied. The method used in the motion requirements study is presented together with the underlying assumptions and a description of the supporting data. Results are given in a form suitable for use in a preliminary design. Visual requirements associated with a television camera/model concept are related. The important parameters are described together with substantiating data and assumptions. Research recommendations are given.

78N10004* ISSUE 1 PAGE 7 CATEGORY 5 RPT#: NASA-CR-152020 D210-11255-1 AD-A051306 CNT#: NAS2-0048 77/08/00 43 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/WEINGH, A.

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS SAP: HC A05/0 A01

SUBJ: /FLIGHT SIMULATION/ PERFORMANCE PREDICTION/ TILT ROTOR AIRCRAFT/ XV-15 AIRCRAFT

MINS: /AERODYNAMIC ENGINEERING/ MATHEMATICAL MODELS/ RIGID ROTORS/ TEST PILOTS

ABA: Author

ABS: A pilot study of an advanced hingeless tilt rotor XV-15 tilt rotor aircraft was carried out. The
evaluation was made by a pilot from NASA-Ames who had previous experience flying a simulation of the current helicopter control system of the NASA-Ames aircraft. It was pointed out that some modifications to the force feel system were needed in order to provide rapid force trimming during rapid maneuvers. Some additional tailoring of the SCAS system was required to achieve good no-flap performance. Pilot's comments that the hingeless rotor XV-15 tilt rotor was favorable. Brief discussion on the mathematical models and the simulator configuration are presented. The maneuvers and pilot comments are given along with some engineering comments.

ABS: The results are presented of a statistical analysis of air accidents involving two- and four-engine commercial aircraft. The general aviation aircraft up to 5.7 tons with emphasis on agricultural aircraft. Based on the whole on accident statistics published by the Civil Aeronautics Board. The occurrence rate of various kinds of accidents, including fatalities or not, was calculated. The causes of the accidents are classified into several major categories of possible directions for general aviation aircraft.

77N32752# ISSUE 23 PAGE 3119 CATEGORY 61 RPT#: NASA-CA-2077 CNT#: 0644-40-601 77/06/10 112 PAGES UNCLASSIFIED DOCUMENT

UTTL: Computer considerations for realistic simulation of a general aviation aircraft model. TLSF: Final Report

AUTH: A/HOME, R. K.; B/FOGARTY, L. E.

Corp: Michigan Univ., Ann Arbor - CSS (Dept of Aerospace Engineering.)

AVA111 NTIS: SPAC 09/09/01

Washington NASA

M105: "FLIGHT SIMULATION/MATHEMATICAL MODELS/REAL TIME OPERATION/ROTORS"

MINS: "TRANSITION/COUPLED SIMULATION/TRANSITION/TRANSITION/MOTIVATION/TIME SIMULATION"

ABA: Author

ABS: Scaled equations were developed to meet requirements for real time computer simulation of the rotor system research aircraft. These equations form the basis for consideration of both digital and hybrid mechanisms for real time simulation. For all digital simulation estimates of the required speed in terms of equivalent operations per second are developed based on the complexity of the equations and the required integration frame rates. For both conventional hybrid simulation and hybrid simulation using time-shared analog elements the amount of required equipment is estimated along with a consideration of the computer system cost. Conventional hybrid mechanism using analog simulation of those rotor equations which involve rotor-spin frequencies (this constitutes the bulk of the equations) requires too much analog equipment. Hybrid simulation using time-sharing techniques for the analog elements appears possible with a reasonable amount of analog equipment. All digital simulation with affordable general purpose computers is not possible because of speed limitations, but specially configured digital computers to have the required speed and constitute the recommended approach.
Vibration analysis of rotor blades with an attached concentrated mass

AUTH: A/URTHY, V. R.; B/BARNA, P. S.
CORP: Old Dominion Univ., Norfolk, Va.
AVAIL:NTIS SAP: HC A03/AF AGI
MAJS: /*MASS DISTRIBUTION*/ROTOR BLADES (TURBOMACHINERY)/ ROTOR LOADS
MINS: /COMPUTER PROGRAMS/ HELICOPTERS/ ROTOR AERODYNAMICS/ TORSIONAL VIBRATION

The effect of an attached concentrated mass on the dynamics of helicopter rotor blades is determined. The point transmission matrix method was used to define, through three completely automated computer programs, the natural vibrational characteristics (natural frequencies and mode shapes) of rotor blades. The problems of coupled flapwise bending, chordwise bending, and torsional vibration of a twisted nonuniform blade and its special subcase pure torsional vibration are discussed. The orthogonality relations that exist between the natural modes of rotor blades with an attached concentrated mass are derived. The effect of pitch, lead, and point mass parameters on the collective, cyclic, and ground, and pure torsional vibration of a seagull rotor blade is determined.

Evaluation of stress on a pilot during agricultural flights based on physiological studies

AUTH: A/MARKIEVicz, L. E.; B/KORADECKA, D.; C/KONARSKA, M.
CORP: Borowic (Loz) Associates, Redwood City, Calif.
AVAIL:NTIS SAP: HC A03/AF AGI
Washington NASA Transl. into ENGLISH from Tech. Lotnicza i Astronaut. (Poland), v. 31, no. 1, 1976 p. 3-16
MAJS: /*HUMAN FACTORS ENGINEERING*/PILOT PERFORMANCE/*STRESS (PHYSIOLOGY)
MINS: / AGRICULTURE/ AIRCRAFT PILOTS/ STRESS (PSYCHOLOGY)

An ergonomic analysis of the development of fatigue in a pilot during agricultural work is presented. Selected indicators of physiological activity during flights on PZL-101 Gawron and An-2 airplanes and Mi-2 and Mi-8 helicopters are studied under various flight conditions.

Sensor for measuring instantaneous angle of attack of helicopter blades

AUTH: A/BARNA, P. S.; B/LIU, H. W.
CORP: Old Dominion Univ., Norfolk, Va.
AVAIL:NTIS SAP: HC A03/AF AGI
MAJS: /*ANGLE OF ATTACK*/MEASURING INSTRUMENTS/ROTARY WINGS
MINS: /HELICOPTERS/ RESEARCH FACILITIES/ ROTOR AERODYNAMICS

Various research activities are reported in the following areas: (1) improving and testing probes; (2) theoretical studies of probe motion; and (3) improving research facilities. It is concluded that satisfactory solutions to the problem of measuring angle of attack of helicopter blades may be found in the near future.

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AUTH: A/MARKIEVicz, L. E.; B/KORADECKA, D.; C/KONARSKA, M.
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Computers for real time flight simulation: A market survey

AUTH: A/BREKEY, G. A.; B/KARPLUS, W. J.
CORP: Computer Sciences Corp., Mountain View, Calif.
An extensive computer market survey was made to determine those available systems suitable for current and future flight simulation studies at Ames Research Center. The primary requirement is for the computation of relatively high frequency content (5 Hz) math models representing powered lift flight vehicles. The Rotors Systems Research Aircraft (RSRA) was used as a benchmark vehicle for computation comparison studies. The general nature of helicopter simulations and a description of the benchmark model are presented, along with detailed discussions of leading candidate systems and comparisons between them.
An interurban helicopter cost model having the capability of selecting an efficient helicopter network for a given city in terms of service and total operating costs was developed. This model is based upon the relationship between total and direct operating costs and the number of block hours of helicopter operation is compiled in terms of a computer program which simulates the operation of an Intranet helicopter fleet over a given network. When applied to specific urban areas, the model produces results in terms of the break-even time per passenger market penetration rate, which is the time when the cost of travel by helicopter is equal to the cost of travel by other modes. The model is used to determine the cost per seat mile and then according to break-even penetration rate.

Research requirements for development of improved helicopter rotor efficiency

Research requirements for developing an improved-efficiency rotor for a civil helicopter are documented. The various design parameters affecting the hover and cruise efficiency of a rotor are surveyed, and the parameters capable of producing the greatest potential improvement are identified. Research and development programs to achieve these improvements are defined, and estimated costs and schedules are presented. Interaction of the improved efficiency rotor with other technologies for an advanced civil helicopter is noted, including its impact on other performance, and maintenance and reliability.

Wind tunnel tests of a two-bladed model rotor to evaluate the TAMI system in descending forward flight

A research investigation was conducted to assess the potential of the tip air mass injection system in reducing the noise output during blade vortex interaction, in designing low speed flight. In general, it was concluded that the noise output due to blade vortex interaction can be reduced by 4 to 6 dB with an equivalent power expenditure of approximately 14 percent of installed power.
reinforcements are positioned. Bolted composite channel sections were selected as the optimum joint construction. The applicability of the single cure composite process to curved airframe sections and the durability of the composite structure in a realistic spectrum fatigue environment, was described.

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Design study of a feedback control system for the Multicyclic Flap System rotor (MFS), TILS: Final Report

AUTHORS: A/McEldrich, R.; J/Perley, R.; C/Howard, H.
CORPORATION: Kaman Aerospace Corp., Bloomfield, Conn. AVAILABILITIES
SAP: N/A, A07/MF 01

MAJORS: Aerodynamic Configurations/Feedback Control/Flaps (Control Surfaces)/Helicopter Control/Actory Wings
MINS: Circuit Diagrams/Harmonic Motion, Servomechanisms/Wind Tunnel Tests

ABA: Author

ABS: The feasibility of automatically providing higher harmonic control to a deflected control flap at the tip of a helicopter rotor blade through feedback of selected independent parameter was investigated. Control parameters were selected for the feedback system. A preliminary circuit was designed to condition the selected parameter, weigh limiting factors, and provide a proper output signal to the multi-cyclic control actuators. Results indicate that feedback control for the higher harmonics is feasible; however, design for a flight system requires an extension of the present analysis which was done for one flight condition - 120 kts, 11,500 lbs gross weight and level flight.
in research project selection. Evaluations of each project's direct and indirect benefits, uncertainty in achieving these benefits, and schedule priority with resource budget and program balance constraints are considered. The combination of the interactive effect of project selection, resource allocation, and scheduling considerations into one model permits trade-off alternatives to be studied. Clients' value judgments are used in evaluating the benefits from each proposed project. The model is applied to the NASA Civil Helicopter Technology Program. Research project priorities for this program are established. Strengths and weaknesses of the model are discussed, and areas of future development are recommended.

77N2177# ISSUE 13 PAGE 1689 CATEGORY 24
RPT#: NASA-CR-145144 SER-70238: VOL-2 CNT#: NASI-13882 77/00/00 50 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/RACKIEWICZ, J. J.
CORP: Sikorsky Aircraft, Stratford, Conn. AVAIL.NTIS SAP: HC A03/MF A01
MAJS: /FATIGUE TESTS/GRAPHITE/LOAD TESTS/ROTOR WINGS
MINS: /COMPOSITE MATERIALS/EPoxy RESINS/HELICOPTERS/LAMINATES
ABA: Author
ABS: Small scale combined load fatigue tests were conducted on six artificially and six naturally weathered test specimens. The test specimen material was unidirectionally oriented A-S graphite - woven glass scrim epoxy resin laminate.

77N21060# ISSUE 12 PAGE 1543 CATEGORY 5 RPT#: NASA-CR-145114 CNT#: NASI-13624 76/12/00 79 PAGES UNCLASSIFIED DOCUMENT
UTTL: Research requirements for development of advanced-technology helicopter transmissions - reduction of maintenance costs
AUTH: A/LEMSKII, A. J.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS SAP: HC A05/MF A01
MAJS: /COST REDUCTION/HELICOPTER ENGINES/MAINTENANCE/MECHANICAL DRIVES
MINS: /CIVIL AVIATION/DESIGN ANALYSIS/ENGINE PARTS/SERVICE LIFE
ABA: Author
ABS: Helicopter drive system technology which would result in the largest benefit in direct maintenance cost when applied to civil helicopters in the 1980 timeframe was developed. A prototype baseline drive system based on 1975 technology provided the basis for comparison against the proposed advanced technology in order to determine the potential for each area recommended for improvement. A specific design example of an advanced-technology main transmission is presented to define improvements for maintainability, weight, producibility, reliability, noise, vibration, and diagnostics. Projections of the technology achievable in the 1980 timeframe are presented. Based on this data, the technologies with the highest payoff (lowest direct maintenance cost) for civil helicopter drive systems are identified.

77N21041# ISSUE 12 PAGE 1538 CATEGORY 5
76/00/00 12 PAGES UNCLASSIFIED DOCUMENT
UTTL: Flight flutter testing of rotary wing aircraft using a control system oscillation technique
AUTH: A/VEN, J. C.; B/VISWANATHAN, S.; C/MATTHYS, C. G.
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL.NTIS SAP: HC A21/MF A01
IN NASA Longley Res. Center Flutter Testing Techn. p. 5-1512 (See N77-21022 12-09)
MAJS: /CONTROL EQUIPMENT/FLUTTER ANALYSIS/OSCILLATIONS/ROTARY WING AIRCRAFT/ROTOR AERODYNAMICS
MINS: /CONTROL STABILITY/ CORIOLIS EFFECT/ELASTIC DAMPING/FOURIER TRANSFORMATION/VERTICAL TAKEOFF AIRCRAFT/XV-15 AIRCRAFT
ABA: Author
ABS: A flight flutter testing technique is described in which the rotor controls are oscillated by series actuators to excite the rotor and airframe modes of interest, which are then allowed to decay. The moving block technique then used to determine the damped frequency and damping variation with rotor speed. The method proved useful for tracking the stability of relatively well damped modes. The results of recently completed flight tests of an experimental soft-in-plane engine are used to illustrate the technique. Included is a discussion of the application of this technique to the investigation of the propeller whirl flutter stability characteristics of the NASA/Army XV-15 VTVL tilt rotor research aircraft.

77N21040# ISSUE 12 PAGE 1537 CATEGORY B
76/00/00 27 PAGES UNCLASSIFIED DOCUMENT
UTTL: Investigation of aerelastic stability phenomena of a helicopter in-flight shake test
AUTH: A/MARO, W. L.; B/EDWARDS, T. C./BRANDT, D. E.

TERMINAL 20 PAGE 58 (ITEMS 216-219 (F 260)
The analytical capability of the helicopter stability program is discussed. The parameters which are found to be critical to the air response characteristics of the soft-in-plane hingeless rotor systems are detailed. A summary of two model test programs, a 1/13.8 Froude-scaled BO-105 model and a 1.87 meter (5.5 foot) diameter Froude-scaled YUH-61A model, are presented with emphasis on the selection of the final parameters which were incorporated in the full scale YUH-61A helicopter. Modal test data for this configuration are shown. The actual test results of the YUH-61A air response in-flight shake test stability are presented. Included are a concise description of the test setup, which employs the Gummow Automated Telemetry System (ATS), the testing technique for recording in-flight stability, and the test procedure used to demonstrate favorable stability characteristics with no in-plane damping augmentation (lag damper removed). The data illustrate the stability trend of air response with forward speed and the stability trend of ground resonance for percent airspeed are presented.

77020118# ISSUE 11 PAGE 1465 CATEGORY 39 CNTR: DAAU02-75-0031 DAAU02-77-C-0040 76/10/00 27 PAGES UNCLASSIFIED DOCUMENT
UTTL: Thermal and Structural Analysis of Helicopter Transmission Housing Using VASTRAN
AVAIL. NTIS
SAP: HC A22/MF A01
MAJS: /CH-47 HELICOPTER, NASTRAN/STRUCTURAL ANALYSIS/TRANSMISSIONS (MACHINE ELEMENTS)
MINS: /FINITE ELEMENT METHOD/HELICOPTER DESIGN/ROTOR BLADES/ THERMAL STRESSES

ABSTRACT

The application of NASTRAN to improve the design of helicopter transmission housings is described. A finite element model of the complete forward rotor transmission housing for the Boeing Vertol CH-47C helicopter was used to study thermal distortion and stress, stiffness, and deflection due to static and dynamic loads, load paths, and design optimization by the control of structural energy distribution. The analytical results are correlated with test data and used to reduce weight and to improve strength, service life, safety, and reliability. The techniques presented, although applied herein to helicopter transmissions, are sufficiently general to be applicable to any power transmission system.

77020500# ISSUE 11 PAGE 1465 CATEGORY 39 CNTR: DAAU02-75-0031 DAAU02-77-C-0040 76/10/00 27 PAGES UNCLASSIFIED DOCUMENT
UTTL: Development of Correlation of NASTRAN Simulation for the AH-1G Helicopter
AVAIL NTIS
SAP: HC A22/MF A01
MAJS: /AIRFRAMES/NASTRAN/STRUCTURAL ANALYSIS/HELICOPTER
MINS: HELICOPTER DESIGN/STATIC TESTS/STRUCTURAL VIBRATION/VIBRATION TESTS

TERMINAL 20 PAGE 59 (ITEMS 220-222 OF 369)
ABA: Author

ABS: NASTRAN was evaluated for vibration analysis of the
helicopter airframe. The first effort involved
development of a NASTRAN model of the AH-1G helicopter
airframe and comprehensive documentation of the model.
The next effort was to assess the validity of the
NASTRAN model by comparisons with static and vibration
tests.

77N19488# ISSUE 10 PAGE 1323 CATEGORY 39
RPT#: NASA-CR-145119 REPT: 699-099-016 CNT#: NASA-13901 76/02/00 160 PAGES UNCLASSIFIED DOCUMENT

UTTL: Correlation of AH-1G airframe test data with a NASTRAN
mathematical model

AUTH: A/CRONKHITIE, J. D.: B/BEYER, V. L.
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL.NTIS
SAP: HC A03/MF A01
MAJS: /MATHEMATICAL MODELS/"MILITARY HELICOPTERS/"NASTRAN/" STRUCTURAL ANALYSIS
MINS: / AIRFRAMES/ COMPUTER PROGRAMS/ HELICOPTER DESIGN/ VIBRATION TESTS

ABA: Author

ABS: Test data was provided for evaluating a mathematical
vibration model of the Bell AH-1G helicopter airframe.
The math model was developed and analyzed using the
NASTRAN structural analysis computer program. Data
from static and dynamic tests were used for comparison
with the math model. Static tests of the fuselage and
tailboom were conducted to verify the stiffness
representation of the NASTRAN model. Dynamic test data
were obtained from shake tests of the airframe and
were used to evaluate the NASTRAN model for
representing the low frequency (below 30 Hz) vibration
response of the airframe.

77N19058# ISSUE 10 PAGE 1262 CATEGORY 5 RPT#: NASA-CR-145116 CNT#: NASA-13624 76/12/00 37 PAGES UNCLASSIFIED DOCUMENT

UTTL: Research requirements for the reduction of helicopter
vibration

AUTH: A/GOODAN, G. S.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS
SAP: HC A03/MF A01
MAJS: /HELICOPTER PERFORMANCE/"STRUCTURAL VIBRATION/" VIBRATION ISOLATORS
MINS: / AIRCRAFT RELIABILITY/ ROTARY WINGS/ STRUCTURAL DESIGN CRITERIA/ TECHNOLOGY ASSESSMENT

ABA: Author

ABS: All prospective approaches to the reduction of
helicopter vibrations were searched to establish insight
for the planning of a corrective research program.
The state of the art as revealed in the
literature is summed up and followed by a discussion
of state-of-the-art solutions and of identified
technological gaps. It is applicable to all
helicopters without regard to size. Extending the
historic trend toward lower vibration levels will
require the successful application of principles which
isolate the fuselage from the rotor system.
Simplicity of the necessary isolation systems should be
facilitated by providing other refinements of the
dynamic design of the system.

77N18155# ISSUE 9 PAGE 1134 CATEGORY 7 RPT#: NASA-CR-145112 CNT#: NASA-15624 76/12/00 36 PAGES UNCLASSIFIED DOCUMENT

UTTL: Research requirements for development of regenerative
engines for helicopters

AUTH: A/LEMPRE, R. D.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS
SAP: HC A03/MF A01

ABA: Author

ABS: The research and technology demonstration requirements
to achieve emergency power capability for a civil
helicopter are documented. The goal for emergency
designation is the ability to hover with one engine
inoperative. Transition to minimum power for
flight, and continue to a safe landing where emergency
power may or may not be required. The best method to
obtain emergency power is to augment the basic engine
design by increasing the engine's speed and
speed and turbine inlet temperature, combined with water-alcohol
injection at the engine inlet. Other methods,
including turbine boost power and flywheel energy,
offer potential for obtaining emergency power for
minimum time durations. Costs and schedules are
estimated for a research and development program
to bring emergency power through a hardware-demonstration
test. Interaction of engine emergency power capability with other helicopter systems is examined.
MAJS: /ENGINE DESIGN/-FUEL CONSUMPTION/-HELECOPTER ENGINES/ GENERATIVE FUEL CELLS
MINS: /ENGINE NOISE/- REGENERATION (ENGINEERING)/ WEIGHT REDUCTION
ABA: Author
ABS: The improved specific fuel consumption of the regenerative engine was compared to a simple-cycle turbo shaft engine. The performance improvement and fuel savings are obtained at the expense of increased engine weight, development and production costs, and maintenance costs. Costs and schedules are estimated for the elements of the research and development program. Interaction of the regenerative engine with other technology goals for an advanced civil helicopter is examined, including its impact on engine noise, hover and cruise performance, helicopter empty weight, drive-system efficiency and weight, one-engine-inoperative hover capability, and maintenance and reliability.

77N16136# ISSUE 9 PAGE 1130 CATEGORY 5 RPT#:
NASA-CR-145120 CNT#: NASA-13801 7/6/00/00 148
PAGES UNCLASSIFIED DOCUMENT
UTIL: Correlation of AH-1G helicopter flight vibration data and tail boom static test data with NASTRAN analytical results
AUTH: A/CRONKITE, J. D.; B/WILSON, H. E.; C/BERRY, V. L.
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL NTIS
SAP: HC A07/MF A01
MAJS: /HELECOPTER PERFORMANCE/-NASTRAN/-STRUCTURAL ANALYSIS /
MINS: / AIRFRAMES/ STATIC TESTS/ TAIL ASSEMBLIES/ TAIL ROTORS
ABA: Author
ABS: Level flight airframe vibration at main rotor excitation frequencies was calculated. A NASTRAN tail boom analysis was compared with test data for evaluation of methods used to determine effective skin in a semimonocoque semi-stringer structure. The flight vibration correlation involved comparison of level flight vibration for two helicopter configurations: clean wing, at light gross weight and wing stores at heavy gross weight. In the tail boom correlation, deflections and internal loads were compared using static test data and a NASTRAN analysis. An iterative procedure was used to determine the amount of effective skin of buckled panels under compression load.

77N17004# ISSUE 8 PAGE 974 CATEGORY 2 RPT#:
NASA-CR-151939 2/30-1000-4-1 VOL-4 CNT#: NASA-4501 7/09/00 4 VOLS 56 PAGES
UNCLASSIFIED DOCUMENT
UTIL: Wind tunnel test on a 1/4.622 Froude scale hingeless rotor, tilt rotor model. Volume 4
AUTH: A/MAGEE, J. P.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL NTIS
SAP: HC A09/MF A01
MAJS: /RIGID ROTORS/-SCALE MODELS/- TILT ROTOR RESEARCH AIRCRAFT P/GRAM/- WIND TUNNEL TESTS
MINS: /AERODYNAMIC CHARACTERISTICS/- CRUISING FLIGHT/- DYNAMIC MODELS/ FROUDE NUMBER/ NASA PROGRAM TABLES (DATA)/ -AERODYNAMIC FORCES/- AIRSPEED/- ATTITUDE (INCINATION)/-ROTOR BLADES (TURBOMACHINERY)/-ROTOR SPEED/- STABILITY DERIVATIVES/- STRESS CONCENTRATION /
THROTTLE LOADS/- WING FLAPS
ABA: Author
ABS: Experimental cruise flight data from a wind tunnel test on a 1/4.622 Froude scale hingeless rotor, tilt rotor model are reported.
SUM: Diverse data are presented. Variables include parametric force, moment and blade fatigue loads. Cruising flight speed, aircraft attitude, rotor control input, wing flap deflection, thrust load, and rotor RPM.
77N17003# ISSUE B PAGE 974 CATEGORY 2 RPT:
NASA-CR-151938 D20-10000-03 VOL 3 CNF: NAS2-9015
76/09/00 4 VOLS 769 PAGES UNCLASSIFIED DOCUMENT
UTTL: Wind tunnel test on a 1/4.622 Froude scale, hingeless rotor, tilt rotor model. Volume 3
AUTH: A/MAGEE, J. P.; B/ALEXANDER, H. R.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL NTIS
SAPT: HC A99/MF A01
MAJS: / RIGID ROTORS/SCALE MODELS/ TILT ROTOR RESEARCH
AIRCRAFT PROGRAM/ WIND TUNNEL TESTS
MINS: / AERODYNAMIC CHARACTERISTICS/ DYNAMIC MODELS/ FROUDE NUMBER/ HOVERING/ LOW SPEED/ NASA PROGRAMS/ TABLES (DATA)/ AERODYNAMIC FORCES/ AIRSPEED/ ATTITUDE (INCLINATION)/ ROTOR BLADES (TURBOMACHINERY)/ ROTOR SPEED/ STABILITY DERIVATIVES/ STRESS CONCENTRATION
/ THRUST LOADS/ WING FLAPS

ABS: For abstract, see 77-17002
SUM: Diverse data are presented; variables include parametric force, moment and blade fatigue loads, hovering to low speed flight, aircraft attitude, rotor control input, wing flap deflection, thrust load, and rotor RPM.

77N17002# ISSUE B PAGE 974 CATEGORY 2 RPT:
NASA-CR-151937 D20-10000-2 VOL 2 CNF: NAS2-9015
76/09/00 4 VOLS 679 PAGES UNCLASSIFIED DOCUMENT
UTTL: Wind tunnel test on a 1/4.622 Froude scale, hingeless rotor, tilt rotor model. Volume 2
AUTH: A/MAGEE, J. P.; B/ALEXANDER, H. R.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL NTIS
SAP: HC A99/MF A01
MAJS: / RIGID ROTORS/SCALE MODELS/ TILT ROTOR RESEARCH
AIRCRAFT PROGRAM/ WIND TUNNEL TESTS
MINS: / AERODYNAMIC CHARACTERISTICS/ DYNAMIC MODELS/ FROUDE NUMBER/ HOVERING/ LOW SPEED/ NASA PROGRAMS/ TABLES (DATA)/ AERODYNAMIC FORCES/ AIRSPEED/ ATTITUDE (INCLINATION)/ ROTOR BLADES (TURBOMACHINERY)/ ROTOR SPEED/ STABILITY DERIVATIVES/ STRESS CONCENTRATION
/ THRUST LOADS/ WING FLAPS

ABA: Author
ABS: Wind tunnel test data on a 1/4.622 Froude scale, hingeless rotor, tilt rotor model are reported for all potential flight conditions through hover and a wide envelope of transitions. A mathematical model was used to describe the rotor system in real time simulation by means of regression analyses. Details of the model test program and data analysis are provided with four data files for hover and transition.
SUM: Diverse data are presented; variables include parametric force, moment and blade fatigue loads, flight range, airspeed, aircraft attitude, rotor control inputs, wing flap deflection, thrust load, and rotor RPM.

77N16950# ISSUE 6 PAGE 972 CATEGORY 2 RPT:
NASA-TF-17395 REPT-337 CNF: NAS2-2791 77/02/00
42 PAGES UNCLASSIFIED DOCUMENT
UTTL: Transonic rotor aerodynamics: Fundamentals of the theory
AUTH: A/ISAY, W. H.
CORP: Scientific Translation Service, Santa Barbara, Calif. AVAIL NTIS
SAP: HC A03/MF A01
MAJS: /HELICOPTERS/ ROTARY WINGS/ ROTOR AERODYNAMICS/ TRANSONIC FLOW
MINS: AERODYNAMIC LOADS/ PRESSURE DISTRIBUTION/ SHOCK WAVE INTERACTION/ THICKNESS/ VISCOSITY

ABA: Author
ABS: A theory is developed in order to calculate the pressure distribution on the blades of a helicopter rotor in forward flight. Neglecting the influence of viscosity the velocity-potential is obtained as well
as the pressure field wave equations with a nonlinear term. Following the theory of wave equations, the influence of accelerated moving shocks on the flow is represented by sink-distributions on the shock surfaces; similarly the loading and thickness-effects of the rotor blades are described by dipoles and source-sink-distributions on the foils.

SUM: No numeric data are presented.

77N12664# ISSUE 3 PAGE 291 CATEGORY 7 RPT#: NASA-TM-X-74341 AD-A025892 CON#: NGR-09-010-095
76/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UTIL: A new capability for predicting helicopter rotor noise in hover and in flight
AUTH: A/BRL, T.: B/FAARSAAT, F.
CORP: Army Air Mobility Research and Development Lab., Hampton, Va. AVAL-NITIS SAP: HC AO2/AF ADI
MAJS: /AIRCRAFT NOISE/*COMPUTER PROGRAMS/*HELICOPTERS/*HOVERING/*ROTARY WINGS
MINS: /ACOUSTIC MEASUREMENT/BLADE TIPS/HIGH FREQUENCIES/SOUND PRESSURE

ABA: GRA

ABS: This paper discusses a new theory and a computer program for realistic calculation of acoustic pressure signature and spectrum of rotor and propeller noise. Many of the common restrictions of already existing theories are removed by using the new theory which is consistent with all previous theories. Only deterministic pressure fluctuations may be used in the program at this stage of development. This will limit the applicability of the program to relatively high tip speeds where it is known that high frequency unsteady pressure fluctuations do not contribute significantly to the sound level. There are very few blade surface pressure measurements and reliable acoustic data available to test the theory in full.

Comparison with the measured acoustic data of a high-speed propeller by Hubbard and Lassiter, using limited aerodynamic data in the blade tip region for acoustic calculations, has shown good agreement so far. One important contribution of the new theory is believed to be the removal of the compactness assumption which can introduce errors in acoustic computations. The new capability will be used to study this effect.

77N10044# ISSUE 1 PAGE 8 CATEGORY 5 RPT#: NASA-CR-2637 R76-911205-47 CON#: NAS1-10560 DA PROJ.
76/10/00 253 PAGES UNCLASSIFIED DOCUMENT

UTIL: Investigation of a bearingless helicopter rotor concept having a composite primary structure TLP:

76N32124# ISSUE 23 PAGE 2951 CATEGORY 1 RPT#: NASA-CR-2757 SRL-3169-0014 CON#: N51-13705
76/01/00 100 PAGES UNCLASSIFIED DOCUMENT

UTIL: The effect of helicopter main rotor blade phasing and spacing on performance, blade loads, and acoustics TLP: Final Report
AUTH: A/GANGHUN, S. T.
AVAL-NITIS SAP: HC $5.00
Washington NASA
MAJS: /ACOUSTIC PROPERTIES/*HELICOPTER PERFORMANCE/*ROTOR AERODYNAMICS/*VARIABLE PITCH PROPELLERS
ABSTRACT

The performance, blade loads, and acoustic characteristics of a variable geometry rotor (VGR) system in forward flight and in a pullup maneuver were determined by the use of existing analytical programs. The investigation considered the independent effects of vertical separation of two three-bladed rotor systems as well as the effects of azimuthal spacing between the blades of the two rotors. The computations were done to determine the effects of these parameters on the performance, blade loads, and acoustic characteristics at two advance ratios in steady-state level flight and for two different pullups at one advance ratio. To evaluate the potential benefits of the VGR concept in forward flight and pullup maneuvers, the results were compared as to performance, oscillatory blade loadings, vibratory forces transmitted to the fixed fuselage, and the rotor noise characteristics of the various VGR configurations with those of the conventional six-bladed rotor system.

ABSTRACT

The equations of motion for the longitudinal dynamics of a tilting prop/rotor aircraft are developed. The analysis represents an extension of the equations of motion. The effects of the longitudinal degrees of freedom of the body (pitch, heave and horizontal velocity) are included. The results of body freedom can be added to the equations of motion for the flexible wing propulsion combination.

ABSTRACT

A model was designed, fabricated and wind tunnel tested to identify some of the parameters which were pertinent to the noise produced by the interaction of the main rotor wake with the tail rotor. The model provided for variations in many geometric and operating parameters. The initial set of tests indicated that the noise produced by the tail rotor was, in general, sensitive to the location of the vortex interaction on the tail rotor disk, direction of rotation, lateral rotor disk spacing, tip speed and the operating mode of the tail rotor; and generally insensitive to main rotor thrust coefficient, longitudinal spacing and tail rotor to main rotor rotational speed ratios. Refinements in the analyses to adequately predict the noise phenomenon have been outlined to complement further experimental investigations.

ABSTRACT

The dynamic synthesis of a helicopter is reported. The method of approach is a variation of the component mode synthesis in the sense that it regards the aircraft as an assemblage of interconnected substructures. The equations of motion are derived in general form by means of the Lagrangian formulation in conjunction with an orderly kinematical procedure that takes into account the superposition of motion of various substructures, thus circumventing constraint problems.
The results of a design review study and evaluation of the XV-15 Tilt Rotor Research Aircraft for flying qualities research application are presented. The objectives of the program were to determine the capability of the XV-15 aircraft and the V/STOLAND system as a safe, inflight facility to provide meaningful research data on flying qualities, flight control systems, and information display systems.

The results are presented of a study to identify those helicopter technology areas which would result in the largest energy (or fuel) savings when applied to large tandem (100 passenger) civil helicopters in the 1985 time frame. Baseline aircraft using 1975 technology in the areas of powerplant, rotor efficiency, parasite drag and structure were sized to a very short haul mission of 100 N.M. and a short haul mission of 200 N.M. A systematic parametric analysis was then conducted to assess the impact of technology improvements. Projections of the technology levels that could be obtained in the 1985 time frame were made and the resources estimated to achieve them. Based on these data, the highest payoff (lowest energy) helicopter technologies are identified.
equipment for airplanes and helicopters, and the technology for performing, organizing, and standardizing aircraft application operations. All forms of aerial agricultural chemical application operations are covered in detail with consideration for the latest data: (1) combating plant pests and diseases. (2) weed suppression. (3) mineral fertilizer application. (4) crop defoliation. (5) desiccation and so on. The latest experience in crew operational procedures and the latest scientific advances are examined. Photographs are included.

76N1813915 ISSUE 9 PAGE 1083 CATEGORY B RPT#: NASA-CR-137729 VIZEX-CR-74-1A CNT#: NAS2-7307 75/10/00 88 PAGES UNCLASSIFIED DOCUMENT
UTILITY: A theoretical study of the application of jet flap circulation control for reduction of rotor power requirements.
AUTH: A/RENAKA, A. R.
CORP: Vizex, Inc., Amherst, N. Y. AVAL.NTIS SAP: HC $5.00
Sponsored in part by AMRD.
MAJUS: /HELICOPTERS/ JET FLAPS/ ROTARY WINGS
MINS: / AERODYNAMIC BALANCE/ COMPUTERIZED SIMULATION/ JET CONTROL/ SHEAR FLOW/ VIBRATION
ABA: Author
ABS: The theoretical potential of a jet flap control system for reducing the vertical and horizontal non-cancelling helicopter rotor blade root shears was investigated. It was determined that the dominant contributor to the rotor power requirements is the requirement to maintain moment trim as well as force trim. It was also found that the requirement to maintain moment trim does not entail a power penalty.

76N181234 ISSUE 9 PAGE 1080 CATEGORY 7 RPT#: NASA-CR-134940 LVC-75-78 CNT#: NAS3-18015 75/10/00 199 PAGES UNCLASSIFIED DOCUMENT
UTILITY: Self-acting seals for helicopter engines
AUTH: A/LYNWANDER, P.
CORP: Avco Lycuma Div., Stratford, Conn. AVAL.NTIS SAP: HC $5.00
MAJUS: /HELICOPTER ENGINES/ SEALS (STOPPERS)
MINS: / GAS TURBINE ENGINES/ SHAFTS (MACHINE ELEMENTS)
ABA: Author
ABS: An experimental evaluation was conducted with NASA-designed self-acting face and circumferential seals for use in the main shaft positions of advanced gas turbine engines. The seals featured Rayleigh step pads (self-acting geometry) for lift augmentation. The tested seals incorporated design improvements over previous self-acting configurations. Self-acting face seals were tested to speeds of 214 m/s (700 ft/sec. 63700 rpm), air pressures of 216.8 N/sq cm abs (314.7 psia), and air temperatures of 688K (778 F)
Self-acting circumferential seals were tested to speeds of 110 m/s (600 ft/sec. 47700 rpm), air pressures of 61.8 N/sq cm abs (89.7 psia), and air temperatures of 711 K (820 F). Self-acting face seals are capable of operating at conditions exceeding conventional seal capabilities. The limit of this capability was found to be the flatness of the seal seat. The self-acting circumferential seal design tested requires further development for use in advanced engines.
76N18107+ ISSUE 9 PAGE 1078 CATEGORY 5 RPT#: NASA-CR-137525 REPT-301-099-009 CNT#: NASA-8084 4/06/01 137 PAGES UNCLASSIFIED DOCUMENT
UTL: Analysis of the wind tunnel test of a tilt rotor power force model TLS: Final Report
AUTH: A/MARR. R. L.; B/FORD. D. G.; C/FERGUSON. S. W.
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL.NTIS
SAP: HC $6.00
MAJS: // TILT ROTOR RESEARCH AIRCRAFT PROGRAM/ MIND TUNNEL TESTS
MINS: / AIRCRAFT PERFORMANCE/ FLIGHT CHARACTERISTICS/ STABILITY DERIVATIVES
ABA: Author
ABS: Two sets of wind tunnel tests were made to determine performance, stability and control, and rotor wake interaction on the airframe, using a one-tenth scale powered force model of a tilt rotor aircraft. Testing covered hover (IGE/OCE), helicopter, conversion, and airplane flight configurations. Forces and moments were recorded for the model from predetermined trim attitudes. Control positions were adjusted to trim flight (one-g lift, pitching moment and drag zero) within the uncorrected test data balance accuracy. Pitch and yaw sweeps were made about the trim attitudes with the control held at the trimmed settings to determine the static stability characteristics. Tail on, tail off, rotation on, and rotors off configurations were tested to determine the rotor wake effects on the empennage. Results are presented and discussed.

76N16958# ISSUE 9 PAGE 1071 CATEGORY 2 RPT#: NASA-CR-137810 SER-50912 CNT#: NASA-6463 75/02/27 297 PAGES UNCLASSIFIED DOCUMENT
UTL: Derivation of equations of motion for multi-blade rotors employing coupled modes and including high twist capability
AUTH: A/SOPHIE. R.
CORP: United Aircraft Corp., Stratford, Conn. AVAIL.NTIS
SAP: HC $9.25
MAJS: // COUPLED MODES/ EQUATIONS OF MOTION/ ROTARY WINGS
MINS: / FLIGHT CHARACTERISTICS/ GUSTS/ HELICOPTERS/ ROTOR AERODYNAMICS
ABA: Author
ABS: The equations of motion are derived for a multiblade rotor. A high twist capability and coupled flattrise- edgewise assumed normal modes are employed instead of uncoupled flattrise- edgewise assumed normal models. The torsion mode is uncoupled. A support system model, consisting of complete helicopters in free flight, or grounded flexible supports, arbitrary rotor-Induced inflow, and arbitrary vertical gust models are also used.

76N16773+ ISSUE 7 PAGE B94 CATEGORY 53 75/11/00 34 PAGES UNCLASSIFIED DOCUMENT
UTL: Reaction of passengers to public service vehicle ride
AUTH: A/CLARKE. M. J.; B/GOODRNE. D. J.
CORP: University College of Swansea (Wales).
MAJS: // COMFORT/ HUMAN REACTIONS// PASSENGERS
MINS: / GROUND EFFECT MACHINES/ HELICOPTERS/ NOISE INTENSITY
// RAIL TRANSPORTATION/ VIBRATION
ABA: Author
ABS: A series of questionnaire studies is described, which was carried out on passengers in public service vehicles in the United Kingdom particularly on the USSR, the United Kingdom and the United States. The effectiveness of the different rating techniques employed is examined and it is demonstrated that useful and reliable information can be obtained on the effects of such physical parameters as vibration, vehicle motion and noise using rating methods which involve no external standards. Some results obtained from analysis of the survey returns are presented.

76N16067+ ISSUE 7 PAGE 802 CATEGORY 5 RPT#: NASA-11-F-19869 CR#: NASA ORDER W-13183 76/02/00 52 PAGES UNCLASSIFIED DOCUMENT
UTL: Helicopters on the Baykal-Amur line
AUTH: A/HAZAROV. V. A.
Writing in the Joint US/ USSR Transp. into English from Izd. Transp. (Moscow), 1975 p 1-72
MAJS: // HELICOPTER DESIGN/ HELICOPTER PERFORMANCE// U.S.S.R.
MINS: / LAND MANAGEMENT/ MILITARY HELICOPTERS/ MILITARY TECHNOLOGY/ UTILITY AIRCRAFT
ABA: Author
ABS: Flight performance and technical specifications of the Mi-8, Mi-6, Mi-10K, Mi-2, Ka-26, Mi-4 and Mi-1 helicopters are reported in relation to their use in the construction of the Baykal-Amur line. The book is designed for pilots, technical personnel and construction leaders and workers on the line.

76N16052# ISSUE 7 PAGE 800 CATEGORY 3 RPT#: NASA-CR-146561 CNT#: NSG-1121 76/02/13 75 PAGES UNCLASSIFIED DOCUMENT
UTL: The role of the helicopter in transportation technology assessment for use in civil aviation
AUTH: A/DJUKAN. J. S.; B/WARNER. D. C.; C/EPSTEIN. D. A.
CORP: Duke Univ., Durham. N. C.
CSS: (Dept. of Civil Engineering.) AVAIL.NTIS SAP: HC $4.50
A general overview is presented of the role that the helicopter plays in the current aviation scene with special emphasis on its use in the airport access function. Technological problems of present-day aircraft are discussed along with some plausible solutions. The economic and regulatory aspects of commercial helicopter operations are presented. Finally, six commercial operations utilizing helicopters are reviewed and conditions that enhance the success of the helicopter in the airport access function are proposed.

76N15063* ISSUE 6 PAGE 666 CATEGORY 5 75/01/00
14 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Acr-ocra: A hybrid LTA aircraft for aerial crane applications
AUTH: A/PERKINS, R. G., JR.; B/DOOLITTLE, D. B. PAA;
B/AILI Am. Eng. Co.)
CORP: Naval Air Systems Command, Washington, D. C.
In MIT Proc. of the Interagency Workshop on Lighter
than Air Vehicles p 571-584 (SEE N76-15015 06-01)

76N13041* ISSUE 4 PAGE 398 CATEGORY 3 RPT:
NASA-CR-2630 M-154 CN#: NASA-29584 75/12/00 77

UTTLE: Analysis of atmospheric flow over a surface protrusion
using the turbulence kinetic energy equation with
reference to aeronaautical operating systems TILSP:
AUTH: A/FROST, W. W.; B/HAPEER, W. L.
CORP: Tennessee Univ. Space Inst., Tullahoma. AVAIL.NIIS
SAP: HT 55.00
Washington NASA

76N15055* ISSUE 6 PAGE 665 CATEGORY 5 75/01/00
12 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Ultra-heavy vertical lift system: The Hell-Stat --
helicopter - airship combination for materials
AUTH: A/PIASECKI, F. N.
In MIT Proc. of the Interagency Workshop on Lighter
than Air Vehicles p 465-476 (SEE N76-15015 06-01)

76N15063* ISSUE 6 PAGE 666 CATEGORY 5 75/01/00
14 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Acr-ocra: A hybrid LTA aircraft for aerial crane applications
AUTH: A/PERKINS, R. G., JR.; B/DOOLITTLE, D. B. PAA;
B/AILI Am. Eng. Co.)
CORP: Naval Air Systems Command, Washington, D. C.
In MIT Proc. of the Interagency Workshop on Lighter
than Air Vehicles p 571-584 (SEE N76-15015 06-01)

76N13041* ISSUE 4 PAGE 398 CATEGORY 3 RPT:
NASA-CR-2630 M-154 CN#: NASA-29584 75/12/00 77

UTTLE: Analysis of atmospheric flow over a surface protrusion
using the turbulence kinetic energy equation with
reference to aeronaautical operating systems TILSP:
AUTH: A/FROST, W. W.; B/HAPEER, W. L.
CORP: Tennessee Univ. Space Inst., Tullahoma. AVAIL.NIIS
SAP: HT 55.00
Washington NASA

76N15055* ISSUE 6 PAGE 665 CATEGORY 5 75/01/00
12 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Ultra-heavy vertical lift system: The Hell-Stat --
helicopter - airship combination for materials
AUTH: A/PIASECKI, F. N.
In MIT Proc. of the Interagency Workshop on Lighter
than Air Vehicles p 465-476 (SEE N76-15015 06-01)
Intensity in the stagnation zone and sharp gradients in intensity along the transition from adverse to favourable pressure gradient. Discussion of the effects of the disturbed wind field in CTDL and STOL aircraft flight path and obstruction clearance standards is given. The results indicate that closer inspection of these presently recommended standards as influenced by wind over irregular terrains is required.

76N11996* ISSUE 3 PAGE 261 CATEGORY 1 75/00/00 10 PAGES UNCLASSIFIED DOCUMENT
UNITL: Expert field aircraft --- history of technology development
CORP: Old Dominion Univ., Norfolk, Va.
In its Gen. Aviation and Community Develop. p 17-26
(SEE N76-11994 03-01)
MAJS: /SHORT TAKEOFF AIRCRAFT*/TECHNOLOGY ASSESSMENT
MINS: / AIRCRAFT CONFIGURATIONS/ AIRCRAFT PERFORMANCE/
HELICOPTERS/ PAYLOADS/ VERTICAL TAKEOFF AIRCRAFT
ABA: F.O.S.
ABS: Short reduced and vertical takeoff aircraft are discussed in terms of technology development and the field length performance through the years is reviewed.

76N10005*# ISSUE 1 PAGE 1 CATEGORY 2 RPT#:
NASA-CR-137772 CNT#: NAS2-7025 75/10/00 48 PAGES
UNCLASSIFIED DOCUMENT
UNITL: Transient airloads computer analysis for simulating wind-induced impulsive noise conditions of a hovering helicopter rotor
AUTH: A/HALL. G. F.
CORP: United Technologies Research Center, East Hartford, Conn.
AVAIL. NTIS SAP: HC $3.75
Sponsored in part by Army Air Mobility R and D Lab., Moffett Field, Calif.
MAJS: /AIRCRAFT NOISE/*COMPUTER PROGRAMS/*GUST LOADS/
HELICOPTERS/*HOVERING*/ROTARY WINGS
MINS: / BLADE TIPS/ COUPLED MODES/ NUMERICAL ANALYSIS/
PERIODIC VARIATIONS/ VORTICES/ WIND (METEOROLOGY)
ABA: Author
ABS: A numerical analysis was developed to determine the airloads on helicopter rotors operating under near-hovering flight conditions capable of producing impulsive noise. A computer program was written in which the solutions for the rotor tip vortex geometry, inflow, aerodynamic response, and airloads are solved in a coupled manner at sequential time steps, with or without the influence of an imposed steady ambient wind or transient gust. The program was developed for future applications in which predicted airloads would be incorporated in an acoustic analysis to attempt to predict and analyze impulsive noise (blade slap). The analysis was applied to a hovering full-scale rotor for which impulsive noise was recorded in the presence of ambient wind. The predicted tip vortex coordinates are in reasonable agreement with the test data, and the blade airload solutions converged to a periodic behavior for an imposed steady ambient wind conditions.

75N33699* ISSUE 24 PAGE 3095 CATEGORY 54 75/05/00 6 PAGES UNCLASSIFIED DOCUMENT
UNITL: Unique wide field of view visual simulation --- of helicopter flight close to earth surface
AUTH: A/NIEEMA. J.
CORP: Army Avionics Lab., Ft. Monmouth, N. J.
Control p 377-382 (SEE N75-33675 24-54)
MAJS: /DISPLAY DEVICES/FLIGHT SIMULATION*/PILOT
PERFORMANCE/VIDEO EQUIPMENT
MINS: /COMPENSATORY TRACKING/ HELICOPTERS/ HORIZONTAL
FLIGHT/ MAN MACHINE SYSTEMS/ MANUAL CONTROL
ABA: Author
ABS: Visual simulations are required to support investigations of the man-machine aspects of helicopter map-of-the-earth flight. The visual simulation requirements are discussed via a visual avionics technology. A wide field of view on the world outside the cockpit is necessary to show adequate visual cues to the pilot. A unique design is described employing three TV monitors, collimating lenses, and electronics to experimentally display a wide field of view without the use of a costly wide angle optical probe.

75N33685* ISSUE 24 PAGE 3963 CATEGORY 54 CNT#:
NAS1-13653 75/05/00 7 PAGES UNCLASSIFIED DOCUMENT
UNITL: A model for simultaneous monitoring and control --- by pilot during helicopter approaches
AUTH: A/CRERRY. R. E.; B/KLEINMAN. D. L.; C/HOFFMAN. W. C.
CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Man-Vehicle Lab.)
In NASA, Ares Res. Center 11th Ann. Conf. on Manual Control p 144-150 (SEE N75-33675 24-54)
MAJS: /APPROACH CONTROL/HELICOPTERS*/MATHEMATICAL MODELS*/
PILOT PERFORMANCE
MINS: / ADAPTIVE CONTROL/ IN-FLIGHT MONITORING/ INSTRUMENT
LANDING SYSTEMS/ MAN MACHINE SYSTEMS
ABA: Author
ABS: Mathematical models of the human operator have been concerned primarily with his input/output...
characteristics and his adaptive behavior to sudden changes in the controlled element dynamics. Newer models have examined the ability of the human to detect failures when acting as a monitor. However, models for simultaneous monitoring and control (e.g., an aircraft pilot flying a split axis approach) are necessary for performing pilot task allocations and for coordinated design of display and control subsystems. Flight test results of simulated instrument helicopter approaches conducted have shown the following: (1) constant speed approaches can be made quite comfortably by the pilots; (2) pilots cannot hover on situation displays alone; and (3) pilots can hover with a flight director display, but feel uncomfortable because they do not have enough time to monitor the situation displays.

75N38311# ISSUE 24 PAGE 2999 CATEGORY 5 RPT#:
NASA-CR-112723 I SER 50944 CNT#: NASA-13479 7/5/06/00
99 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Study to investigate design, fabrication and test of low cost concepts for large hybrid composite helicopter fuselage. Phase I TSLP: Final Report
AUTH: A/ADAMS, K. M.; B/LOUGHLIN, J. J.
MAJS: COMPOSITE MATERIALS/FUSELAGES/HYBRID HELICOPTERS/MIXED CRAFTS
MINS: AIRCRAFT DESIGN/COSTS/EPoxy RESINS/GRAFITE/PRODUCTION ENGINEERING

ABS: The development of a frame/airframe/skin fabrication technique for composite airframe construction was studied as a low cost approach to the manufacture of large helicopter airframe components. A center cabin aluminum airframe section of the Sikorsky CH-53D helicopter was selected for evaluation as a composite structure. The design, as developed, is composed of two woven KEVLAR-49/epoxy skin and graphite/epoxy frames and stringers. To support the selection of this composite design concept a materials study was conducted to develop and select a cure compatible graphite and KEVLAR-49/epoxy resin system, and a foam system capable of maintaining shape and integrity under the processing conditions established. The materials selected were: Avercoat 5200/Thornel T-300 graphite, Nomex 5200/KEVLAR-49 woven fabric, and Stainz 8747 polyurethane foam. Eight specimens were fabricated, representative of the frame, stringer, and splice joint attachments. Evaluation of the results of analysis and test indicate that design predictability is excellent except for some conservatism of the complex frame splice.

75N32112# ISSUE 23 PAGE 2677 CATEGORY 6 RPT#:
NASA-CR-112765 CNT#: NASA-12876 7/5/06/00 163
PAGES UNCLASSIFIED DOCUMENT

UTILITY: Instrumentation requirements for aircraft parameter identification with application to the helicopter
AUTH: A/SORENSEN, J. A.; B/MOHR, R. L.; C/CLINE, T. B.
CORP: Systems Control, Inc., Palo Alto, Calif. AVAIL.NTIS
SAP: NC-00.25
MAJS: AIRCRAFT INSTRUMENTS/HELICOPTERS/INSTRUMENT ERRORS
MINS: AIRCRAFT CONTROL/AIRCRAFT STABILITY/ERROR ANALYSIS
/FLIGHT TESTS/PARAMETERIZATION

ABS: The extent to which instrumentation error causes degradation in the knowledge of stability and control derivatives identified for flight tests was studied along with the resultant degradation of the flight system performance base on these derivatives. The error in measurement and data processing systems used for parameter identification, error analysis techniques, and the effects of instrumentation errors on the accuracy of parameter estimates are discussed. The analysis programs were used to study instrumentation error effects on the accuracy of the identified stability and control derivatives of the CH-46 helicopter.
Oscillations can be significantly reduced by either reducing the torsional natural frequency or introducing viscous damping in the torsional degree of freedom. A preliminary investigation was conducted to determine the feasibility and practicality of alleviating the stall problem by means of boundary layer control. The results indicate that boundary layer control would be effective in reducing the higher harmonics of torsional oscillations due to stall and that its implementation would not require excessive power or suction rates.

75N31503* ISSUE 22 PAGE 2799 CATEGORY 39 CNT#: DAA02-74-C-0040 75/09/00 20 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/MAGEE, J. P.; B/CLARK, R. D.; C/REYNOLDS, H. R.

ABSTRACT: A finite element NASTRAN model of the complete forward rotor transmission housing for the Boeing Vertol CH-47 helicopter was developed and applied to reduce transmission vibration/noise at its source. In addition to a description of the model, a technique for vibration/noise prediction and reduction is outlined. Also included are the dynamic response as predicted by NASTRAN, test data, the use of strain energy methods to optimize the housing for minimum vibration/noise, and determination of design modifications which will be manufactured and tested. The techniques presented are not restricted to helicopters but are applicable to any power transmission system. The transmission housing model developed can be used further to evaluate static and dynamic stresses, thermal distortions, deflections and load paths, plus safety/quality and composite materials.

75N30146* ISSUE 21 PAGE 2619 CATEGORY 5 RPT#: NASA-CR-137599 0210-10859-1 CNT#: NAS2-8048 74/11/00 459 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/MAGEE, J. P.; B/CLARK, R. D.; C/REYNOLDS, H. R.

ABSTRACT: Results of conceptual design studies of 1985 commercial STOL transports that utilized tiltrotors. Volume 1

75N30147* ISSUE 21 PAGE 2619 CATEGORY 5 RPT#: NASA-CR-137600 0210-10859-2 CNT#: NAS2-8048 74/11/00 407 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/MAGEE, J. P.; B/CLARK, R. D.; C/REYNOLDS, H. R.

ABSTRACT: Results of conceptual design studies of 1985 commercial VTOL transports that utilized tiltrotors. Volume 2

75N30145* ISSUE 21 PAGE 2619 CATEGORY 5 RPT#: NASA-CR-137601 0210-10859-3 CNT#: NAS2-8048 74/11/00 256 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/WIDDISON, C. A.; B/MAGEE, J. P.; C/REYNOLDS, H. R.

ABSTRACT: Results of conceptual design studies of a commercial STOL tiltrotor transport.
STOL tilt rotor commercial aircraft for the 1985 time frame are presented. The details of aircraft size, performance, flying qualities, noise, and cost are included. The savings in terms of fuel economy resulting from STOL operations compared with VTOL vehicles are determined.

75N30021* ISSUE 21 PAGE 2602 CATEGORY 5 7/05/00 31 PAGES UNCLASSIFIED DOCUMENT

UTIL: Rotorcraft derivative identification from analytical models and flight test data

AUTH: A/MOLUSIS, J. A.
CORP: United Aircraft Corp., Stratford, Conn. CSS: ( Sikorsky Aircraft Div.)
In AGARD Methods for Aircraft State and Parameter Identification 31 p (SEE NT5-29997 21-01) Sponsored in part by NASA and USAAMRL

MAJS: /**FLIGHT TESTS/ROTARY WING AIRCRAFT/**STABILITY DERIVATIVES
MINS: / AERODYNAMIC COEFFICIENTS/ AIRCRAFT STABILITY/ HELICOPTER PERFORMANCE/ MATHEMATICAL MODELS/ PARAMETERIZATION/ PREDICTION ANALYSIS TECHNIQUES

ABA: Author

ABS: A general procedure is presented for systematic development of rotorcraft models for use in systems identification, which includes fuselage and rotor degrees of freedom (DOF). Formulations for rigid blade flap and lag as well as the normal mode representation of an elastic blade are developed for hingeless and articulated rotor systems. The method of multiblade coordinates is used to obtain linear constant coefficient state variable models of various levels of approximation. Two of the approximate models, a 6 DOF, are identified from a nonlinear articulated helicopter computer simulation. The results demonstrate the accuracy attainable for each model. Advance results outline the status of rotorcraft modeling and systems identification and indicate areas that require further investigation.

75N30031* ISSUE 20 PAGE 2474 CATEGORY 2 RPT#: NASA-CR-132686 CNTR: NGL-39-009-172 75/00/00 197 PAGES UNCLASSIFIED DOCUMENT

UTIL: Unsteady vortex lattice techniques applied to wake formation and performance of the statically thrusting propeller

AUTH: A/MALL, G. F.
CORP: Pennsylvania State Univ., University Park. AVAIL.NIIS SAP: HC $7.00

MAJS: / AERODYNAMICS/HELICOPTER WAVES/ VORTICES
MINS: / AERODYNAMIC FORCES/ LIFT DEVICES/ WING LOADING

ABA: Author

ABS: The application is considered of vortex lattice techniques to the problem of describing the aerodynamics and performance of statically thrusting helicopter. A numerical lifting surface theory to predict the aerodynamic forces and power is performed. The choruvite and spanwise loading is modelled by bound vortices fixed to a twisted flat plate surface. In order to eliminate any a priori assumptions regarding the wake shape, it is assured that the propeller starts from rest. The wake is generated in time and allowed to deform. Under its own self-induced velocity field as the motion of the propeller progresses. The bound circulation distribution is then determined with time by applying the flow tangency boundary condition at certain selected control points on the blades. The aerodynamics of the infinite wing and finite wing are also considered. The details of wake formation and roll-up are investigated. Particularly the local and induction effect. It is concluded that proper wake roll-up and roll-up rates can be established by considering the details of motion at the instant of start.

75N28041* ISSUE 19 PAGE 2344 CATEGORY 3 RPT#:

NASA-CR-2532 SER-50891 CNTR: NA52-8079 75/05/00 27 PAGES UNCLASSIFIED DOCUMENT

UTIL: Conceptual design study of 1965 commercial VTOL transports that utilize rotors

AUTH: A/KEFFORD, R. F. K.; B/KNIGHT, C. L.
CORP: United Aircraft Corp., Stratford, Conn. CSS: ( Sikorsky Aircraft Div.) AVAIL.NIIS SAP: HC $5.75

MAJS: / AIRCRAFT DESIGN/HELICOPTERS/ TRANSPORT AIRCRAFT/ VERTICAL TAKEOFF AIRCRAFT
MINS: / AIRCRAFT CONFIGURATIONS/ COSTS/ SHORT HAUL AIRCRAFT

ABA: Author

ABS: Conceptual design studies of pure and compound helicopter commercial short-haul transport aircraft for initial fabrication in 1965 were performed to determine their technical and economic feasibility. One-hundred-passenger configurations were optimized for minimum direct operating cost consistent with productivity and marketability, with emphasis on proper account of mass properties, performance and handling qualities adequacy, and suppression of internal and external noise. The effect of external noise constraints was assessed, in terms of gross weight and direct operating cost, for each aircraft.
noise studies are discussed. The acoustic characteristics of the wind tunnel were obtained by employing calibration techniques. The noise level was measured by using a microphone at the far field, the noise level at the far field being determined by using a sound source. The sound pressure level versus frequency was obtained on the wind tunnel wall and compared with the corresponding calibrated values. Fiberglass board-block units were installed on the wall of the tunnel. The free field was increased significantly after this treatment and the chamber was cut off. The cut-off frequency was reduced to 160 Hz from the original design frequency of 250 Hz. The flow field characteristics of the wind tunnel were measured by using an anemometer and a microphone. A dynamometer system was designed to measure the steady and unsteady components of the wind tunnel. A theoretical method for calculating the formula was developed to scale the rotational noise and blade slap noise data of model rotors to full-scale helicopter rotors.

**ADDRESS**:

75N21267# ISSUE 13 PAGE 1465 CATEGORY 5 RPT:
NASA CR-13611 ARD-1-2100 CNT#: NASA CR-13611
74/10/00 113 PAGES UNCLASSIFIED DOCUMENT

**AUTH**: A/GLEICH, D.

**CORP**: Arde, Inc., Mahwah, N.J.

**MAJS**: CONFIGURATION MATERIALS/FRACTURE STRENGTH/IMPACT RESISTANCE/ROTOR WINGS

**MINS**: CRACK PROPAGATION/CLASS FIBERS/HELICOPTER PROPELLER DRIVE/IMPACT TESTING/STAINLESS STEELS/TERMINAL BALLISTICS

**ABSTRACT**:

Pre-stressed composite spar specimens were fabricated and evaluated by crack propagation and ballistic penetration tests. The crack propagation tests on flawed specimens showed that the pre-stressed composite spars grow significantly before the crack spars propagate. Ductile damage from three high velocity 30 mm projectile hits was confined to three small holes in the ballistic test specimen. No fragmentation or crack propagation was observed indicating good ballistic damage resistance. Rotor attachment approaches and improved structural performance configurations were identified. Design theory was verified by tests. The pre-stressed composite spar configuration consisted of a highly stressed high-strength ARDFORM 301 stainless steel liner wrapped with pretensioned...
S-994 fiberglass.

75N15243# ISSUE 11 PAGE 1195 CATEGORY 7 RPT#: NASA-CR-134739 Lyc-74-55 CNT#: NAS3-16823 74/10/00 72 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Development of self-acting seals for helicopter engines

AUTH: A/L.W. NANDER, P.

CORP: Avco Lycoming Div., Stratford, Conn. AVAIL.NTIS SAP: HC $4.25

MAJLS: /GAS TURBINE ENGINES/HELICOPTER ENGINES/PACKINGS (SEALS)/PERFORMANCE TESTS

MINS: / EQUIPMENT SPECIFICATIONS/ MATERIALS TESTS/ PRODUCT DEVELOPMENT

ABA: Author

ABS: An experimental evaluation of a NASA-designed self-acting face seal for use in advanced gas turbine main shaft positions was conducted. The seal incorporated Rayleigh step pads (self-acting geometry) for lift augmentation. Satisfactory performance of the gas film seal was demonstrated in a 500-hour endurance test at speeds to 183 m/s (600 ft/sec. 54,000 rpm) and air pressure differential of 137 newtons per square centimeter (190.7 psi). Carbon wear was minor. Tests were also conducted with seal seat runout greater than that expected in engine operation and in a severe sand and dust environment. Seal operation was satisfactory in both these detrimental modes of operation.

75N18220# ISSUE 10 PAGE 1068 CATEGORY 5 RPT#: NASA-CR-132578 D10-1-1001-11 CNT#: NASA-13142 74/11/00 127 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Documenting helicopter operations from an energy standpoint

AUTH: A/DAVIS, S. J.; B/STEPNIEKSI, W. Z.

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS SAP: HC $5.75

MAJLS: /ENERGY CONSUMPTION/HELICOPTER PERFORMANCE/ HELICOPTERS

MINS: /AIRCRAFT CONFIGURATIONS/ DATA BAGES/ DRAG REDUCTION/ FUEL CONSUMPTION/ PERFORMANCE PREDICTION/ SAFETY MANAGEMENT

ABA: Author

ABS: Results are presented of a study of the relative and absolute energy consumption of helicopters, including limited comparisons with fixed-wing aircraft, and selected surface transportation vehicles. Additional comparisons were made to determine the level of reduction in energy consumption expected from the application of advanced technologies to the helicopter design and sizing process. It was found that improvements in helicopter consumption characteristics can be accomplished through the utilization of advanced technology to reduce drag, structures weight, and powerplant fuel consumption.

75N18178# ISSUE 10 PAGE 1062 CATEGORY 2 RPT#: NASA-CR-25452 CNT#: NASA-10856 75/01/00 115 PAGES UNCLASSIFIED DOCUMENT


AUTH: A/SUTION, L. R.; B/RINEHART, S. A.


MAJLS: /DYNAMIC RESPONSE/HELICOPTER CONTROL/ROTARY WINGS/ ROTOR AERODYNAMICS

MINS: /AERODYNAMIC FORCES/ COMPUTER PROGRAMS/ EQUATIONS OF F.O.M./ NUMERICAL ANALYSIS

ABA: Author

ABS: A theoretical analysis is developed for a coupled helicopter rotor system to allow determination of the loads and dynamic response behavior of helicopter rotor systems in both steady-state forward flight and maneuvers. The effects of an anisotropically supported swashplate or gyroscopic control system and a deformed free wake on the rotor system dynamic response behavior are included in the analysis.

75N15640# ISSUE 7 PAGE 732 CATEGORY 5 RPT#: NASA-CR-132546 SER-50905 CNT#: NASA-11563 75/00/00 173 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Flight investigation of rotor/vehicle state feedback

AUTH: A/BRenzrenski, S. J.; B/COOPER, D. E.


Sponsored in part by Army Air Mobility R and D Lab., Hampton, Va.

MAJLS: /FEEDBACK CONTROL/FLIGHT TESTS/HELICOPTERS

MINS: /DIGITAL COMPUTERS/ HARMONIC OSCILLATION/ KALMAN FILTERS/ SERVOMECHANISMS/ SIGNAL PROCESSING

ABA: F.O.S.

ABS: The feasibility of using control feedback on rotor tip-path-plane motion or body state as a means of altering rotor and fuselage response in a prescribed manner was investigated to determine the practical limitations of in-flight utilization of a digital computer which conditions and shapes rotor flapping and fuselage state information as feedback signals, before routing these signals to the differential servo actuators. The analysis and test of various feedback schemes are discussed. Test results show that a Kalman
estimator routine which is based on only the first harmonic contributions of blade flapping yields tip-path-plane coefficients which are adequate for use in feedback systems at speeds up to 150 kts.

75NI100G* ISSUE 1 PAGE 15 CATEGORY 9 RPT:
NASA-CR-132522 REPT-50601 CN#: NASA-12641
74/10/00 118 PAGES UNCLASSIFIED DOCUMENT
UTTL: NASA-Langley helicopter tower instrumentation systems
AUTH: A/STOFFEL, S. W.
CORP: Wyle Labs., Inc., Hampton, Va. CSS: (Scientific Services and Systems Group.) AVALNTIS SAP: HC $5.25
MAJS: /HELIOPER DESIGN/MEASURING INSTRUMENTS/TEST FACILITIES/TOWERS
MINS: /DISPLAY DEVICES/ FREQUENCY RESPONSE/ INSTRUMENT ERRORS/ ROTARY WINGS
ABA: A.A.D.
ABS: Background information is presented for the helicopter control test facility. In preface to a more detailed discussion of major subsystems equipment, including error considerations, frequency response, and display instrumentation.

75NI12279# ISSUE 3 PAGE 298 CATEGORY 35 RPT:
NASA-CR-134289 ED2076 TWP-72 004 CN#: NAS9-12200
72/08/00 43 PAGES UNCLASSIFIED DOCUMENT
UTTL: Correlation of missions 191, 31M and helicopter photography -- aerial photography and mapping of terrain areas in Texas
AUTH: A/DRYAN, B. A.; B/TUNNEL, S. H.
MAJS: /FREQUENCY RESPONSE/HELIOPER CONTROL/NUMERICAL ANALYSIS/STIFF ROTORS/VIBRATION DAMPINGS
MINS: /NAS9 PERIODIC VARIATIONS/ SERVOCONTROL/ TRANSFER FUNCTIONS
ABA: Author
ABS: The reduction of the n per rev. pitch and vertical vibrations of an n-bladed rotor by n per rev. sinusoidal variations of the collective pitch of each rotor is investigated. The numerical results presented refer to a four-bladed, 7.5-foot model and are based on frequency response tests conducted under a NASA sponsored research program. The following subjects are treated: extraction of the rotor transfer functions (.073R hub flapping and model thrust versus servovalve command, amplitude and phase), calculation of servo command ripples required to compensate .073R hub flapping (3P and 5P) and model thrust (4P), evaluation of the effect of the vibratory control inputs on blade loads, and theoretical prediction of the root flapping moments generated by 0 to 5P perturbations of the feathering angle and root angle of attack. Five operating conditions are investigated covering advance ratios from approximately 0.2 to 0.85. The feasibility of vibration reduction by periodic variation on conventional controls is...
evaluated.

74N43514* ISSUE 24 PAGE 2904 CATEGORY 2 74/00/00 12 PAGES UNCLASSIFIED DOCUMENT
UTIL: Engine/airframe interface dynamics experience
AUTH: A/FREDRICKSON, C.
In NASA, Ames Res. Center Rotorcraft Dyn. p 249-260
(SEE N74-34489 24-02)
MAJS: *AIRFRAMES/HELICOPTER ENGINES/MECHANICAL DRIVES/ROTARY WINGS
MINS: AERODYNAMIC STABILITY/CRITICAL VELOCITY/ROTATING SHAFTS/STRUCTURAL VIBRATION
ABA: Author:
ABS: Problems of engine/drive system torsional stability, engine and output shaft critical speeds, and engine vibration at helicopter rotor order frequencies are discussed, and test data and analyses presented. Also presented is a rotor/drive system dynamics problem not directly related to the engine.

74N43513* ISSUE 24 PAGE 2904 CATEGORY 32 74/00/00 10 PAGES UNCLASSIFIED DOCUMENT
UTIL: Identification of structural parameters from helicopter dynamic test data
AUTH: A/GIANSALE, N.; B/FLANNELEY, W. G.
CORP: Kaman Aircraft Corp., Bloomfield, Conn.
In NASA, Ames Res. Center Rotorcraft Dyn. p 239-248
(SEE N74-34489 24-02)
MAJS: *DAMPING/DYNAMIC STRUCTURAL ANALYSIS/HELICOPTERS/RESONANT FREQUENCIES
MINS: COMPUTERIZED SIMULATION/DYNAMIC RESPONSE/FUSELAGES/MATHEMATICAL MODELS
ABA: Author:
ABS: A method is presented for obtaining the mass, stiffness, and damping parameters of a linear mathematical model, having fewer degrees of freedom than the structure it represents, directly from dynamic response measurements on the actual helicopter without a priori knowledge of the physical characteristics of the fuselage. The only input information required in the formulation is the approximate natural frequency of each mode and mobility data measured proximate to these frequencies with sinusoidal force excitation applied at only one point on the vehicle. The practicality and numerical soundness of the theoretical development was demonstrated through a computer simulation of an experimental program.

74N34509* ISSUE 24 PAGE 2904 CATEGORY 1 CNTF: DA-AROOLD-1-247-G112 74/00/00 14 PAGES UNCLASSIFIED DOCUMENT
UTIL: Open and closed loop stability of hingeless rotor airfoil and ground resonance
AUTH: A/YOUNG, M. I.; B/BAILEY, D. R.; C/HERSCHEIN, N. S.
CORP: Delaware Univ., Newark
In NASA, Ames Res. Center Rotorcraft Dyn. p 205-218
(SEE N74-34489 24-02)
MAJS: *DAMPING/FLIGHT STABILITY TESTS/RESONANCE/RIGID ROTORS
MINS: DYNAMIC STABILITY/FEEDBACK CONTROL/HELICOPTER PERFORMANCE
ABA: Author:
ABS: The air and ground resonance instabilities of hingeless rotor helicopters are examined on a relatively broad parametric basis including the effects of blade tuning, virtual hinge locations, and blade hysteresis damping, as well as size and scale effects in the gross weight range from 5,000 to 48,000 pounds. A special case of a 72,000 pound helicopter resonance instability is also included. The study shows that nominally moderate and readily achievable levels of blade inertial hysteresis damping in conjunction with a variety of tuning and/or feedback conditions are highly effective in dealing with these instabilities. Tip weights and reductions in pre-coning angles are also shown to be effective means for improving the air resonance instability.

74N43508* ISSUE 24 PAGE 2904 CATEGORY 2 74/00/00 6 PAGES UNCLASSIFIED DOCUMENT
UTIL: Hub moment springs on two-bladed teetering rotors
AUTH: A/SONNECIT, W.; B/TEJ, J.
CORP: Bell Helicopter Co., Fort Worth, Tex.
In NASA, Ames Res. Center Rotorcraft Dyn. p 195-204
(SEE N74-34489 24-02)
MAJS: *HELICOPTER PERFORMANCE/HUBS/ROTARY WINGS/TEETERING/WEIGHTLESSNESS
MINS: AIRCRAFT STABILITY/FLIGHT PATHS
ABA: Author:
ABS: Two-bladed teetering rotors with elastic flapwing hinge restraint are shown to be suitable for zero-g flight. The alternating moment component introduced into the fuselage by the hinge spring can be balanced about the aircraft center of gravity by alternating hub shear. Such shears can be produced in proper magnitude, frequency, and phase by additional unloading of the hub and by judicious choice of the location of the first flapwing cantilevered natural frequency. Trends of theoretical results agree with test results from a small scale model and a modified OH-58A helicopter.
74N34507* ISSUE 24 PAGE 2903 CATEGORY 2
74/00/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTL: Comparison of flight data and analysis for hingeless rotor regressive inflow mode stability
AUTH: A/ANDERSON, W. D.; B/JOHNSTON, J. F.
(SEE N74-34489 24-02)
MAJS: /AERODYNAMIC STABILITY/ MILITARY HELICOPTERS/ RIGID ROTORS
MINS: / AIRCRAFT CONTROL/ GYROSCOPES/ HELICOPTER PERFORMANCE
ABA: Author

ABS: Analytical and experimental data obtained during the development of the AH-56A covering stability of the regressive inflow mode, including coupling with other modes such as body and rotor plunge are reported. Data were obtained on two distinctly different control systems: both gyro controlled, but one with feathering moment feedback and the other with direct flapping feedback. A review was made of analytical procedures employed in investigating the stability of this mode and a comparison was made of the analytical and experimental data. The effect of certain parameters including blade group sweep, delta 3, alpha, vehicle roll inertia, inflow frequency, and rpm and forward speed on the mode were also reviewed. It was shown that the stability of this mode is treatable by analysis and that adequate stability is achievable without recourse to auxiliary inflow damping devices.

74N34504* ISSUE 24 PAGE 2903 CATEGORY 2
74/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: An application of Floquet theory to prediction of mechanical instability --- helicopter rotor blades
AUTH: A/HARMON, C. E.
CORP: Army Air Mobility Research and Development Lab., Hampton, Va.
In NASA, Ames Res. Center Rotorcraft Dyn. p 147-158
(SEE N74-34489 24-02)
MAJS: /FLOQUET THEOREM/ HELICOPTER PERFORMANCE/ MECHANICAL IMPEDANCE/ ROTARY WINGS
MINS: / ANISOTROPY/ EQUATIONS OF MOTION/ HUBS/ MATRICES (MATHEMATICS)/ OSCILLATION DAMPERS/ ROTOR AERODYNAMICS
ABA: Author

ABS: The problem of helicopter mechanical instability is considered for the case where one blade damper is inactive, and it is shown that if the hub is considered to be nonisotropic, the equations of motion have periodic coefficients which cannot be eliminated. The Floquet transition matrix method is shown to be an effective way of dealing with the nonisotropic hub and nonisotropic rotor situation. Time history calculations are examined and shown to be inferior to the Floquet technique for determining system stability. It is shown that instabilities which occur when one blade damper is inoperative may consist of nearly pure blade motion or they may be similar to the classical mechanical instability.

74N34502* ISSUE 24 PAGE 2903 CATEGORY 2
74/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Application to rotary wings of a simplified aerodynamic lifting surface theory for unsteady compressible flow
AUTH: A/RAO, B. M.; B/JOHNSON, W. P.
CORP: Texas A&M Univ., College Station. CSS: (Dept. of Aerospace Engineering.)
In NASA, Ames Res. Center Rotorcraft Dyn. p 127-135
(SEE N74-34489 24-02) Sponsored in part by ARDC
MAJS: /AERODYNAMIC CHARACTERISTICS/ COMPRESSIBLE FLOW/ HELICOPTER CONTROL/ ROTARY WINGS/ ROTOR LIFT
MINS: / AERODYNAMIC COEFFICIENTS/ FLUTTER/ HUERING/ LOAD DISTRIBUTION (FORCES)/ RIGID ROTORS/ ROTOR AERODYNAMICS
ABA: Author

ABS: A general method of predicting airloads is applied to helicopter rotor blades on a full three-dimensional
basis using the general theory developed for a rotor blade at the psi = pi/2 position where flutter is most likely to occur. Calculations of aerodynamic coefficients for use in flutter analysis are made for forward and hovering flight with low inflow. The results are compared with values given by two-dimensional strip theory for a rigid rotor hinged at its root. The comparisons indicate the inadequacies of strip theory for airflow prediction. One important conclusion drawn from this study is that the curved wake has a substantial effect on the chordwise load distribution.

74N34501* ISSUE 24 PAGE 2903 CATEGORY 2 CNT#: DAU002-72-C-0093 74/00/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Control load envelope shaping by live twist
AUTH: A/YARZANIN, F. J., JR.; B/MIRICK, P. H. PAA:
B/Army Air Mobility R and D Lab., Fort Eustis, Va.
In NASA. Ames Res. Center, Rocketcraft Dyn. p 115-125
(SEE 74-34489 24-02)
MAJ.: /AERODYNAMIC LOADS/HELIKOPEER CONTROL/ROTOR
AERODYNAMICS/TORSIONAL STRESS/TWISTING
MINS: /AIRSPEED/ROTATING STALLS/Stiffness
AVA: Author
ABS: Rotor control systems experience a rapid load drop resulting from retreating blade stall during flight conditions of high blade loading or airspeeds. An investigation was undertaken to determine the effect of changing blade torsional properties on the rotor flight envelope. The results of this study show that reducing the blade stiffness to introduce more blade live twist significantly reduces the large retreating blade control loads, while expanding the flight envelope and reducing retreating blade stall loads.

74N34500* ISSUE 24 PAGE 2903 CATEGORY 2
74/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTIL: The effect of cyclic feathering motions on dynamic rotor loads... for helicopters
AUTH: A/HARVEY, K. W.
CORP: Bell Helicopter Co., Fort Worth, Tex.
In NASA. Ames Res. Center, Rocketcraft Dyn. p 107-114
(SEE 74-34489 24-02)
MAJ.: /AERODYNAMIC LOADS/CYCLIC LOADS/FEATHERING/HELIKOPPER CONTROL/ROTOR AERODYNAMICS
MINS: /DEFLECTION/ELASTIC DEFORMATION/INERTIA/NUMERICAL ANALYSIS/PITCH (INCLINATION)/ROTARY WINGS
AVA: Author
ABS: The dynamic loads of a helicopter rotor in forward flight are influenced significantly by the geometric pitch angles between the structural axes of the hub and blade sections and the plane of rotation. The analytical study presented includes elastic coupling between in-plane and out-of-plane deflections as a function of geometric pitch between the plane of rotation and the principal axes of inertia of each blade. The numerical evaluation is based on a transient analysis using lumped mass and elastic substructure techniques. A comparison of cases with and without cyclic feathering motion shows the effect on computed dynamic rotor loads.

74N34499* ISSUE 24 PAGE 2902 CATEGORY 3
74/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Application of antiresonance theory to helicopters
AUTH: A/BARTLETT, F. D., JR.; B/FLANNEY, W. G.
CORP: Haman Aerospace Corp., Bloomfield, Conn.
In NASA. Ames Res. Center, Rocketcraft Dyn. p 101-106
(SEE 74-34489 24-02)
MAJ.: /HELIKOPEER CONTROL/RESONANT VIBRATION
MINS: /ABSORBERS/EQUIPMENT/EIGENVALUES/ITERATION/MATRICES (MATHMATICS)/NODES/STANDING WAVES/VIBRATION ISOLATORS
AVA: Author
ABS: Antiresonance theory is the principle underlying nonresonant nodes in a structure, and covers both nonresonant nodes occurring naturally and those introduced by devices such as dynamic absorbers and antiresonant isolators. The dynamic antiresonant vibration isolator (DAV) and the nodal mode are examples of the applications of transfer antiresonances. It is shown that antiresonances are eigenvalues, and that they can be determined by matrix iteration. Applications of antiresonance theory to helicopter engineering problems, using the antiresonant eigenvalue equation, are suggested.

74N34499* ISSUE 24 PAGE 2902 CATEGORY 2
74/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTIL: Helicopter gust response characteristics including unsteady aerodynamic stall effects
AUTH: A/ARCOIDACOMO, P. J.; B/BERGSTROM, R. R.; C/ALBERTER, W. T., JR. PAA: C/Army Air Mobility R
D Lab., Fort Eustis, Va.
In NASA. Ames Res. Center, Rocketcraft Dyn. p 91-100
(SEE 74-34489 24-02)
MAJ.: /AERODYNAMIC STALLING/GUST LOADS/HELIKOPEER
PERFORMANCE
MINS: /AIRCRAFT/STABILITY/ATMOSPHERIC TURBULENCE/FLIGHT
CHARACTERISTICS/ROTOR AERODYNAMICS

TERMINAL 20 PAGE 78 (ITEMS 288-291 OF 389)
ABA: Author

ABS: The results of an analytical study to evaluate the general response characteristics of a helicopter subjected to various types of discrete gust encounters are presented. The analysis employed was a nonlinear coupled, multi-blade rotor/fuselage analysis including the effects of blade flexibility and unsteady aerodynamic stall. Only the controlled response of the basic aircraft without any aircraft stability augmentation was considered. A discussion of the basic differences between gust sensitivity of fixed and rotary wing aircraft is presented. The effects of several rotor configuration and aircraft operating parameters on initial gust-induced load factor and blade-bend/blade-flap stress and pushed loads are discussed.

74N34497* ISSUE 24 PAGE 2502 CATEGORY 2 CNT#: D6HC04-71-C-0048 74/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Coupled rotor/airframe vibration prediction methods

AUTH: A/STALEY, J. A.; B/SCIARRA, J. J.


In NASA. Ames Res. Center. Rotorcraft Dyn. p 81-90 (SEE N74-34499 24-02)

MAJS: /DYNAMIC STRUCTURAL ANALYSIS/ROTARY WINGS/VIBRATION TESTS

MINS: AIRFRAMES/ COMPUTER PROGRAMS/ HELICOPTERS/ ROTORS

ABA: Author

ABS: The problems of airframe structural dynamics and of coupled rotor/airframe vibration are discussed. Several finite element computer programs (including NASTRAN) and methods for idealization and computation of airframe modes and frequencies and forced response are reviewed. Methods for obtaining a simultaneous rotor and fuselage vibratory response, determining effectiveness of vibration control devices, and energy methods for structural optimization are also discussed. Application of these methods is shown for the vibration prediction of the model 347 helicopter.

74N34495* ISSUE 24 PAGE 2502 CATEGORY 2 74/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Flexible dynamics of hingeless helicopter blades at moderate and high advance ratios

AUTH: A/FRIEDMAN, P. J.; B/SILVERTHORN, L. J.


MAJS: RIGID ROTORS/ROTOR AERODYNAMICS/ TIME LAPSE

MINS: AERODYNAMIC LOADS/ AIRCRAFT STABILITY/ FLIGHT TESTS/ HELICOPTERS

ABA: Author

ABS: Equations for large amplitude coupled flapping motion of a hingeless elastic helicopter blade in forward flight are derived. Only a torsionally rigid blade excited by quasi-steady aerodynamic loads is considered. The effects of reversed flow together with some new terms due to forward flight are included. Using Galerkin's method the spatial dependence is eliminated and the equations are linearized about a suitable equilibrium position. The resulting system of equations is solved using multivariable Floquet-Liapunov theory, and the transition matrix at the end of the period is evaluated by two separate methods. Results illustrating the effects of forward flight and various important blade parameters on the stability boundaries are presented.

74N34456* ISSUE 24 PAGE 2502 CATEGORY 32 74/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Correlation of finite-element structural dynamic analysis with measured free vibration characteristics for a full-scale helicopter fuselage

AUTH: A/LEANCOBERG, I. J.; B/DEAN, M. W.; C/PALATINO, R.

PAA: C (Naval Air Systems Command)

CORP: United Aircraft Corp., Stratford, Conn.

In NASA. Ames Res. Center. Rotorcraft Dyn. p 67-80 (SEE N74-34459 24-02)
74N34493* ISSUE 24 PAGE 2902 CATEGORY 2
74/00/00 9 PAGES UNCLASSIFIED DOCUMENT
UTL: Dynamic analysis of multi-degree-of-freedom systems using phasing matrices
AUTH: A/BIELAWSKI, R. L.
CORP: United Aircraft Corp., East Hartford, Conn.
CSS: (Research Labs.)
In NASA, Ames Res. Center Rotorcraft Dyn. p 35-43 (See N74-34469 24-02)
MAJS: /DEGREES OF FREEDOM/DYNAMIC CHARACTERISTICS/*
MINS: /FLUTTER/HELICOPTERS/PITCH (INCLINATION)/ ROTOR BLADES/TORSION
ABA: Author
ABS: A mathematical technique is presented for improved analysis of a wide class of dynamic and aeroelastic systems characterized by several degrees-of-freedom. The technique enables greater utilization of the usual eigensolution obtained from the system dynamic equations by systematizing the identification of destabilizing and/or stiffening forces. Included as illustrative examples of the use of the technique are analyses of a helicopter rotor blade for bending-torsion divergence and flutter and for pitch-lag/flap instability.

74N34492* ISSUE 24 PAGE 2902 CATEGORY 2
74/00/00 10 PAGES UNCLASSIFIED DOCUMENT
UTL: Computer experiments on periodic systems identification using rotor blade transient flapping-torsion responses at high advance ratio
AUTH: A/HOPENEMSER, K. H.; B/PREMLEWICI, D. A.
CORP: Washington Univ., St. Louis, Mo.
In NASA, Ames Res. Center Rotorcraft Dyn. p 25-34 (See N74-34469 24-02)
MAJS: /FLAPPING HINGES/ROTOR BLADES/SYSTEMS STABILITY/TORSION RESPONSE
MINS: /COMPUTERS/FLIGHT CONTROL/ROTARY WING AIRCRAFT/TORSION
ABA: Author
ABS: Computer experiments on periodic systems identification using rotor blade transient flapping-torsion responses at high advance ratio. These experiments utilized a linear model of the rotorcraft dynamics and are aimed at improving the accuracy of the analysis techniques. The results show the importance of considering the effects of blade flapping and torsion on the overall dynamic behavior of the rotorcraft system.
mode, only short time responses are considered here, where rotor-body coupling is of importance. Thus the body motion consists of pitch, roll and vertical motion, omitting linear longitudinal and lateral and yaw perturbations. Flv. analytical models of varying degree of sophistication are applied to a hypothetical helicopter operating up to .B rotor advance ratio. Stability and response data are obtained for the basic helicopter and for the vehicle with two simple control feedback systems.

74N3194B** ISSUE 21 PAGE 2572 CATEGORY 15
RPT#: NASA-CR-120997 SER-50791 CNT#: NASA-15684 7/09/10 122 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/HAYDEN, T. S.; B/KELLER, C. H., JR.
MAJS: /HELECOPTER PROPELLER DRIVE/ PACKINGS (SEALS)/SHAFTS (ELECTRIC ELEMENTS)
MINS: /EQUIPMENT SPECIFICATIONS/ MECHANICAL PROPERTIES/
PERFORMANCE TESTS
ABA: Author
ABS: A detailed approach for the selection and design of seals for helicopter transmissions is presented. There are two major types of seals presently being considered: lip type seals and mechanical type seals. Lip type seals can be divided in conventional lip seals and hydrodynamic lip seals. Conventional lip seals can be designed for low-speed, low-pressure, high-temperature sealing. Hydrodynamic lip seals although they are as pressure and temperature limited as conventional lip seals, can operate at a higher speed. Mechanical type seals are comprised of face seals and circumferential seals. Face seals are capable of high speed, high pressure, and high temperature. Circumferential seals can be used in high-speed and high-temperature applications, but will leak excessively at moderate pressures. The performance goals of transmission seals are a life at least equal to the scheduled overhaul interval of the gearbox component and a leakage rate of near zero.

74N3194B** ISSUE 21 PAGE 2572 CATEGORY 15
RPT#: NASA-CR-120997 SER-50791 CNT#: NASA-15684 7/09/10 122 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/HAYDEN, T. S.; B/KELLER, C. H., JR.
MAJS: /HELECOPTER PROPELLER DRIVE/ PACKINGS (SEALS)/SHAFTS (ELECTRIC ELEMENTS)
MINS: /EQUIPMENT SPECIFICATIONS/ MECHANICAL PROPERTIES/
PERFORMANCE TESTS
ABA: Author
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RPT#: NASA-CR-120997 SER-50791 CNT#: NASA-15684 7/09/10 122 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/HAYDEN, T. S.; B/KELLER, C. H., JR.
MAJS: /HELECOPTER PROPELLER DRIVE/ PACKINGS (SEALS)/SHAFTS (ELECTRIC ELEMENTS)
MINS: /EQUIPMENT SPECIFICATIONS/ MECHANICAL PROPERTIES/
PERFORMANCE TESTS
ABA: Author
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74N3194B** ISSUE 21 PAGE 2572 CATEGORY 15
RPT#: NASA-CR-120997 SER-50791 CNT#: NASA-15684 7/09/10 122 PAGES UNCLASSIFIED DOCUMENT
AUTH: A/HAYDEN, T. S.; B/KELLER, C. H., JR.
MAJS: /HELECOPTER PROPELLER DRIVE/ PACKINGS (SEALS)/SHAFTS (ELECTRIC ELEMENTS)
MINS: /EQUIPMENT SPECIFICATIONS/ MECHANICAL PROPERTIES/
PERFORMANCE TESTS
ABA: Author
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VIBRATION MEASUREMENT

ABA: Author

ABS: An analytical study of stresses in the blades recorded during the tests of the DH 2011 jet flap rotor was performed. The main objective of the study was to compare the experimental results with analytically determined stresses. The comparison extended over 15 specific flight cases has been only partially successful. In fact computed 3P and 4P stress components showed only a poor correlation with the tests data obtained. It is believed that the simplified model of aerelastic effects used is mainly responsible for this lack of agreement with test results.

74N26561** ISSUE 16 PAGE 1919 CATEGORY 14
CNY: NAS9-12200 73/03/00 11 PAGES UNCLASSIFIED DOCUMENT

UTIL: Program CALIB --- for computing noise levels for helicopter version of S-191 filter wheel spectrometer

AUTH: A/MEK/LOWITZ, M. A.
CORP: Lornhech Electronics Co. Houston, Tex. AVAIL. NTIS

MAJS: A/FLIGHTS, COMPUTER PROGRAMS, HELICOPTERS, NOISE INTENSITY

MINS: CALIBRATING, INPUT/OUTPUT ROUTINES, PUNCHED CARDS, SPECTROMETERS, SUBROUTINES

ABA: R. C.

ABS: The program CALIB, which was written to compute noise levels and average signal levels of aperture radiance for the helicopter version of the S-191 filter wheel spectrometer is described. The program functions, and input description are included along with a compiled program listing.

74N25567** ISSUE 15 PAGE 1746 CATEGORY 2
RPT#: NASA-CR-132430 CNY: NAS1-12495

UTIL: Helicopter derivative identification from analytic models and flight test data

AUTH: A/KOLB, S. J.; B/BRIGGS, S.

MAJS: FLYING TESTS, HELICOPTERS, MATHEMATICAL MODELS, STABILITY DERIVATIVES

MINS: DEGREES OF FREEDOM, KALMAN FILTERS, LEAST SQUARES, METHOD, ROTARY WINGS

ABA: Author

ABS: Recent results of stability derivative identification from helicopter analytic models and flight test data are presented. Six and nine degree-of-freedom (DOF) linear models are identified from an analytic nonlinear helicopter simulation using a least square technique. The identified models are compared with the convensional partial differentiation method for obtaining derivatives to form the basis for interpretation of derivatives identified from flight data. Six degree-of-freedom models are identified from CH-53A and CH-54B flight data, using an extended Kalman filter modified to process several maneuvers simultaneously. The priori derivative estimate is obtained by optimal filtering of the data and then using a least square method. The results demonstrate that a six DOF identified model is sufficient to determine the low frequency mdes of motion, but a nine DOF rotor/body model is necessary for proper representation of short-term response.

74N25567** ISSUE 15 PAGE 1744 CATEGORY 2

UTIL: Community acceptance of helicopter noise: Criteria

AUTH: A/MUSCH, C. L.; B/KING, R. J.

MAJS: A/Acoustic MEASUREMENT, AEROACOUSTIC NOISE, HELICOPTERS, NOISE INTENSITY

MINS: CITIES, HUMAN REACTIONS, HUMAN TOLERANCES, SOUND PROPAGATION

ABA: Author

ABS: A study was conducted to define those criteria necessary for civil helicopter operations to be acoustically acceptable to the communities from which they operate and over which they fly. The study involved surveying existing domestic and foreign Federal regulations and guidelines, state and local noise ordinances, results of community noise annoyance studies, and results of individual aircraft noise annoyance studies, and results of individual aircraft noise annoyance studies in order to establish the criteria. The final criteria selection are based on the Day-Night Level, L sub DN, a measure of total noise exposure. The basic rating unit is the A weighted sound pressure level (dBA) which has accuracy comparable to other units currently used for aircraft. An L sub DN of 60 is recommended as a criterion for areas where the ambient noise is below 58 dBA. An L sub DN value 2 dBA above the local ambient is recommended for areas where the ambient is above 58 dBA.
UUTL: Civil helicopter noise assessment study Boeing-Vertol model 347 ... recommendations for reduction of helicopter noise levels. /\LSP: Final Report.

AUTH: A/HINTERKEUSER, E. G.; B/STERNFELD, H., Jr.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS

MAJS: /AERODYNAMIC NOISE/*HELICOPTERS/*NOISE INTENSITY/* NOISE REDUCTION/*TRANSPORT AIRCRAFT
MINS: / ACOUSTIC MEASUREMENT/* ACOUSTIC PROPERTIES/* FLIGHT PATHS/* HELICOPTER DESIGN

ABA: Author

ABS: A study was conducted to forecast the noise restrictions which may be imposed on civil transport helicopters in the 1975-1985 time period. Certification and community acceptance criteria were predicted. A 50 passenger tandem rotor helicopter based on the Boeing-Vertol Model 347 was studied to determine the noise reductions required, and the means of achieving them. Some of the important study recommendations are: (1) certification levels should be equivalent to 95 EPNdB at data points located at 500 feet to each side of the touchdown/takeoff point, and 1000 feet from this point directly under the approach and departure flight path. (2) community acceptance should be measured as Equivalent Noise Level (Leq), based on dBA, with separate limits for day and night operations, and (3) in order to comply with the above guidelines, the Model 347 helicopter will require studies and tests leading to several modifications.

74N20663* ISSUE 12 PAGE 1373 CATEGORY 2 RPT#: NASA CR-114760 HH-74-28 CNT#: NAS2-7254 73/00/00 70 PAGES UNCLASSIFIED DOCUMENT

UUTL: Noise levels of operational helicopters of the OH-6 type designed to meet the LCH mission --- acoustic properties for various helicopter configurations

AUTH: A/WAGNER, R. A.
CORP: Hughes Helicopters, Culver City, Calif. AVAIL.NTIS

SAP: HC $6.50

MAJS: / ACOUSTIC PROPERTIES/* AERODYNAMIC NOISE/* HELICOPTER PERFORMANCE/* OH-6 HELICOPTER/* ROTOR AERODYNAMICS
MINS: / ACOUSTIC MEASUREMENT/* AERODYNAMIC CONFIGURATIONS/* NOISE INTENSITY/* NOISE PROPAGATION

ABA: Author

ABS: Formulas relating overall sound pressure level (OASPL) to parameters such as horsepower required, tip speed, and thrust for main and tail rotors are presented for standard and quieted helicopters. Formulas relating OASPL to engine parameters such as horsepower output and percent power turbine rpm are presented for unmodified and modified engines. The linear scale was used in preference to any of the weighted scales because it resulted in more consistent agreement with the test data when the SPL is expressed in the usual parameters of tip speed, thrust generated and power required. It is recognized that the linear scale does not adequately reflect hearing response, and hence is not a good absolute measure for detection by humans. However, linear OASPL is believed to be useful as a relative means of comparing noise level variations of individual components in similar helicopters with reasonably modest design changes.

74N19662* ISSUE 11 PAGE 1245 CATEGORY 2 RPT#: NASA TT F-806 CNT#: NASAW-2465 74/04/00 52 PAGES UNCLASSIFIED DOCUMENT

UUTL: Civil aviation in the USSR (the fiftieth anniversary of its formation)

AUTH: A/ASKENOV, A. F.
CORP: Techtran Corp., Silver Spring, Md. AVAIL.NTIS

SAP: HC $3.75


MAJS: /AERODYNAMIC CONFIGURATIONS/* AERODYNAMIC CONFIGURATIONS/* AIRCRAFT DESIGN/* AIRCRAFT INDUSTRY/* ECONOMIC FACTORS

ABA: Author

ABS: The history of the development of Soviet civil aviation has paralleled the burgeoning of Soviet power and influence in the 20th century. The influence of aircraft on transportation and national unity is naturally emphasized, while such valuable contributions as the transport of the sick by air, construction of buildings using helicopters, and the aerial surveying and extermination of insect pests are discussed as well. Many types of Soviet aircraft are described and compared as to size, range and other characteristics.

74N18754* ISSUE 10 PAGE 1121 CATEGORY 2 RPT#: NASA CR 114749 D210-10666-2 CNT#: NAS2-5473

SAP: HC $6.50

73/09/15 66 PAGES UNCLASSIFIED DOCUMENT

UUTL: Acoustical Properties of a model rotor in nonaxial flight --- wind tunnel model noise measurements

AUTH: A/HINTERKEUSER, E. G.
CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL.NTIS

SAP: HC $6.50

Sponsored in part by Army Air Mobility R and D Lab., Moffett Field, Calif.
MINS: CH-54 HELICOPTER/ DATA ACQUISITION/ DATA PROCESSING/ H-53 HELICOPTER/ KALMAN FILTERS/ NUMERICAL ANALYSIS

ABA: Author

ABS: A method is developed for extracting six degree-of-freedom stability and control derivatives from helicopter flight data. Different combinations of filtering and derivative estimation were preformed and used with a Bayesian approach for derivative identification. The combination of filtering and derivative estimation resulted in a more accurate flight test data, which was determined and applied to CH-53A and CH-54B flight data. The method found to be most accurate consists of (1) filtering flight test data with a digital filter, followed by an extended Kalman filter (2) identifying a derivative estimate with a least square estimator, and (3) obtaining derivatives with the Bayesian derivative extraction method.
adverse aerodynamic phenomena produced by vortex interference. The ogee tip design was found to substantially reduce the concentrated core intensity of the tip vortex, and could thus prove beneficial for the relief of blade-vortex interaction problems. However, the ogee tip was found to reduce hover performance at model scale.

74N15711* ISSUE 7 PAGE 744 CATEGORY 2 RPT#: NASA-CR-114664 D22-10059-1 CNT#: NAS2-6505 73/10/00 873 PAGES UNCLASSIFIED DOCUMENT

UTIL: V/STOL tilt rotor aircraft study: Wind tunnel tests of a full scale hingeless prop/rotor designed for the Boeing Model 222 tilt rotor aircraft

AUTH: A/KADEE, J. P.; B/ALEXANDER, H. G.

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL. NTIS

SAP: HC $45.75

MAJS: */TILT ROTOR RESEARCH AIRCRAFT PROGRAM/*V/STOL AIRCRAFT/*WIND TUNNEL TESTS

MINS: */DYNAMIC RESPONSE/ FEEDBACK CONTROL/* LOAD TESTS/*RIGID ROTORS/* ROTOR AERODYNAMICS/*STABILITY DERIVATIVES

ABA: Author

ABS: System identification methods have been applied to rotorcraft to estimate stability derivatives from transient flight control response data. When these applications assumed a linear constant coefficient representation of the rotorcraft, the computer experiments used transient responses in flap-bending and torsion of a rotor blade at high advance ratio which is a rapidly time varying periodic system. It was found that a simple system identification method applying a linear sequential estimator also called least square estimator or equation of motion estimator is suitable for this periodic system and can be used directly if only the acceleration data are noise polluted. In the case of noise being present also in the state variable data the direct application of the estimator gave poor results.

74N14757* ISSUE 6 PAGE 622 CATEGORY 2 RPT#: NASA-CR-114709 CNT#: NAS2-4151 73/06/00 92 PAGES UNCLASSIFIED DOCUMENT

UTIL: Concepts for a theoretical and experimental study of lifting rotor random loads and vibrations (the effects of some rotor feedback systems on rotor-body dynamics) Phase 7-A

AUTH: A/TOHENEMSER, K. H.; B/YIN, S. K.

CORP: Washington Univ., St. Louis, Mo. CSS: (School of Engineering and Applied Science.) AVAIL. NTIS SAP: HC $6.75

MAJS: */AERODYNAMIC CHARACTERISTICS/*AERODYNAMIC FORCES/*ROTOR WINGS/*ROTOR AERODYNAMICS/*TILTING ROTORS

MINS: */ AERODYNAMIC CONFIGURATIONS/*FLIGHT TESTS/*PERFORMANCE TESTS/ ROTOR BLADES

ABA: Author

ABS: The effects of three gyroless rotor feedback systems: (1) coning feedback, (2) proportional tilting feedback, and (3) a combination of these on the rotor-body dynamics of hingeless rotorcraft are studied with a simplified analytical model in the advance ratio range from 0 to 0.8. Combinations of feedback phase angles and control phase angles are selected to minimize cross-coupling and control sensitivity changes between low and high speed flight. For the feedback systems thus selected the effects of feedback gain and control actuator time lag on the stability both with fixed hub and in free flight is studied, whereby the rotorcraft is free in pitch, roll and vertical motion but otherwise restrained. For the free flight, it is studied, whereby the rotorcraft is free in pitch, roll and vertical motion but otherwise restrained. For the free flight conditions the effects of a horizontal tail are also determined in itself and in combination with the rotor

74N15711* ISSUE 7 PAGE 744 CATEGORY 2 RPT#: NASA-CR-114664 D22-10059-1 CNT#: NAS2-6505 73/10/00 873 PAGES UNCLASSIFIED DOCUMENT

UTIL: V/STOL tilt rotor aircraft study: Wind tunnel tests of a full scale hingeless prop/rotor designed for the Boeing Model 222 tilt rotor aircraft

AUTH: A/KADEE, J. P.; B/ALEXANDER, H. G.

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL. NTIS

SAP: HC $45.75

MAJS: */TILT ROTOR RESEARCH AIRCRAFT PROGRAM/*V/STOL AIRCRAFT/*WIND TUNNEL TESTS

MINS: */DYNAMIC RESPONSE/ FEEDBACK CONTROL/* LOAD TESTS/*RIGID ROTORS/* ROTOR AERODYNAMICS/*STABILITY DERIVATIVES

ABA: Author

ABS: System identification methods have been applied to rotorcraft to estimate stability derivatives from transient flight control response data. When these applications assumed a linear constant coefficient representation of the rotorcraft, the computer experiments used transient responses in flap-bending and torsion of a rotor blade at high advance ratio which is a rapidly time varying periodic system. It was found that a simple system identification method applying a linear sequential estimator also called least square estimator or equation of motion estimator is suitable for this periodic system and can be used directly if only the acceleration data are noise polluted. In the case of noise being present also in the state variable data the direct application of the estimator gave poor results.

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MAJS: */AERODYNAMIC CHARACTERISTICS/*AERODYNAMIC FORCES/*ROTOR WINGS/*ROTOR AERODYNAMICS/*TILTING ROTORS

MINS: */ AERODYNAMIC CONFIGURATIONS/*FLIGHT TESTS/*PERFORMANCE TESTS/ ROTOR BLADES

ABA: Author

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AUTH: A/KADEE, J. P.; B/ALEXANDER, H. G.

CORP: Boeing Vertol Co., Philadelphia, Pa. AVAIL. NTIS

SAP: HC $45.75

MAJS: */TILT ROTOR RESEARCH AIRCRAFT PROGRAM/*V/STOL AIRCRAFT/*WIND TUNNEL TESTS

MINS: */DYNAMIC RESPONSE/ FEEDBACK CONTROL/* LOAD TESTS/*RIGID ROTORS/* ROTOR AERODYNAMICS/*STABILITY DERIVATIVES

ABA: Author

ABS: System identification methods have been applied to rotorcraft to estimate stability derivatives from transient flight control response data. When these applications assumed a linear constant coefficient representation of the rotorcraft, the computer experiments used transient responses in flap-bending and torsion of a rotor blade at high advance ratio which is a rapidly time varying periodic system. It was found that a simple system identification method applying a linear sequential estimator also called least square estimator or equation of motion estimator is suitable for this periodic system and can be used directly if only the acceleration data are noise polluted. In the case of noise being present also in the state variable data the direct application of the estimator gave poor results.

74N14757* ISSUE 6 PAGE 622 CATEGORY 2 RPT#: NASA-CR-114709 CNT#: NAS2-4151 73/06/00 92 PAGES UNCLASSIFIED DOCUMENT

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AUTH: A/TOHENEMSER, K. H.; B/YIN, S. K.

CORP: Washington Univ., St. Louis, Mo. CSS: (School of Engineering and Applied Science.) AVAIL. NTIS SAP: HC $6.75

MAJS: */AERODYNAMIC CHARACTERISTICS/*AERODYNAMIC FORCES/*ROTOR WINGS/*ROTOR AERODYNAMICS/*TILTING ROTORS

MINS: */ AERODYNAMIC CONFIGURATIONS/*FLIGHT TESTS/*PERFORMANCE TESTS/ ROTOR BLADES

ABA: Author

ABS: The effects of three gyroless rotor feedback systems: (1) coning feedback, (2) proportional tilting feedback, and (3) a combination of these on the rotor-body dynamics of hingeless rotorcraft are studied with a simplified analytical model in the advance ratio range from 0 to 0.8. Combinations of feedback phase angles and control phase angles are selected to minimize cross-coupling and control sensitivity changes between low and high speed flight. For the feedback systems thus selected the effects of feedback gain and control actuator time lag on the stability both with fixed hub and in free flight is studied, whereby the rotorcraft is free in pitch, roll and vertical motion but otherwise restrained. For the free flight, it is studied, whereby the rotorcraft is free in pitch, roll and vertical motion but otherwise restrained. For the free flight conditions the effects of a horizontal tail are also determined in itself and in combination with the rotor

TERMINAL 20 PAGE B6 (ITEMS 316- 318 OF 389)
feedback systems.

74N14621* ISSUE 5 PAGE 603 CATEGORY 8 73/09/00 18 PAGES UNCLASSIFIED DOCUMENT

UTTL: NASTRAN data generation of helicopter fuselages using interactive graphics --- preprocessor system for finite element analysis using IBM computer
AUTH: A/SAINSBURY-CARTER, J. B.; B/CONWAY, J. H. CORP: United Aircraft Corp., Stratford, Conn. CSS: (Sikorsky Aircraft.)
In NASA - Langley Res. Center NASTRAN: Users' Experiences p 661-678 (SEE N74-14586 05-32)
MAJS: */AIRFRAMES/*/COMPUTER PROGRAMS/*/FINITE ELEMENT METHOD
/HOELICPTER DESIGN/*STRUCTURAL ANALYSIS
MINS: */COMPUTER GRAPHICS/*DISPLAY DEVICES/*OPERATING SYSTEMS (COMPUTERS)
ABA: Author

ABS: The development and implementation of a preprocessor system for the finite element analysis of helicopter fuselages is described. The system utilizes interactive graphics for the generation, display, and editing of NASTRAN data for fuselage models. It is operated from an IBM 2250 cathode ray tube (CRT) console driven by an IBM 370/145 computer. Real time interaction plus automatic data generation reduces the nominal 6 to 10 week time for manual generation and checking of data to a few days. The interactive graphics system consists of a series of satellite programs operated from a central NASTRAN systems monitor. Fuselage structural models including the outer shell and internal structure may be rapidly generated. All numbering systems are automatically assigned. Hard copy plots of the model labeled with GRID or elements 10's are also available. General purpose programs for displaying and editing NASTRAN data are included in the system. Utilization of the NASTRAN interactive graphics system has made possible the multiple finite element analysis of complex helicopter fuselage structures within design schedules.

74N14616* ISSUE 5 PAGE 602 CATEGORY 32 73/09/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Static and dynamic helicopter airframe analysis with NASTRAN
In NASA - Langley Res. Center NASTRAN: Users' Experiences p 611-619 (SEE N74-14566 05-32)
MAJS: */AIRFRAMES/*/COMPUTER PROGRAMS/*/DYNAMIC LOADS/*/HELICOPTERS/*/STATIC LOADS/*/STRUCTURAL ANALYSIS/*/STRUCTURAL ENGINEERING

MINS: /COMPUTER TECHNIQUES/Helicopter DESIGN/NUMERICAL ANALYSIS/STRUCTURAL STABILITY
ABA: Author

ABS: The use of NASTRAN at Bell Helicopter Company for structural static and dynamic analysis of a helicopter airframe is described. Analysis of airframe internal loads, main rotor isolation systems, and airframe vibration is discussed. The use of each rigid format for these types of analysis is summarized. Suggested improvements to NASTRAN to increase its effectiveness in performing helicopter airframe analysis are given.

74N13717* ISSUE 5 PAGE 485 CATEGORY 2 RPT#: NASA-TT-F-15195 CNT#: NASW-2483 73/12/00 54 PAGES UNCLASSIFIED DOCUMENT

UTTL: New technologies and profitability of helicopters -- application of helicopters to commercial operations
AVAIL.NTIS SAP: HC $4.75
MAJS: */CIVIL AVIATION/*/COMMERCIAL AIRCRAFT/*/COST EFFECTIVENESS/Helicopter PERFORMANCE
MINS: */AERODYNAMIC CHARACTERISTICS/*/AERODYNAMIC CONFIGURATIONS/*/COST ANALYSIS/*/ECOLOGICS
ABA: Author

ABS: A study was conducted to determine the economic aspects of helicopter operation for commercial purposes. Concepts of specific cost and cost per kilogram provide the basis for the analysis. The fundamental characteristics of helicopters which determine its mission and profitability are discussed. Specific areas investigated are: (1) fatigue life of components, (2) noise reduction, (3) vibration reduction, (4) optimization of rotory wings, and (5) application of composite materials for helicopter construction.

74N13715* ISSUE 5 PAGE 485 CATEGORY 2 RPT#: NASA-CR-136504 SUDAAR-459 CNT#: NAS2-5143 73/06/00 88 PAGES UNCLASSIFIED DOCUMENT

UTTL: Automatic control of a helicopter with a hanging load -- development and evaluation of automatic pilot for use with S-61 helicopter
AUTH: A/GUPTA, N. K.; B/BRYSON, A. E., Jr. CORP: Stanford Univ., Calif. CSS: (Guidance and Control Lab.) AVAIL.NTIS SAP: HC $6.50
MAJS: */AUTOMATIC PILOTS/*/HELICOPTER CONTROL/*/HELICOPTER PERFORMANCE/*/S-61 HELICOPTER
An autopilot logic is designed here for controlling a helicopter with a hanging load. A 16th order model for the system is decoupled into four subsystems: (1) a second order system for yawing motion, (2) a second order system for vertical motion, (3) a sixth order system for longitudinal motion, and (4) a sixth order system for lateral motion. A measuring scheme, which could be used in remote areas, is developed and filters are designed to estimate the state variables from these measurements. The autopilot can be used to move the load over short distances without retracting the cables. This is done by automatically shifting the autopilot modes from position-hold (hover) to acceleration-hold to velocity-hold (cruise) to deceleration-hold to velocity-hold (near hover) to position-hold (hover). Use of such an autopilot might save considerable turnaround time. The Sikorsky S-61 helicopter is chosen as an example vehicle. The performance of the controlled system is studied in the presence of longitudinal and lateral winds.

A study of rotor blade aerelastic stability was carried out, using an analytic model of a two-dimensional airfoil undergoing dynamic stall and an elastomechanical representation including flapping, flapwise bending and torsional degrees of freedom. Results for a hovering rotor demonstrated that the models used are capable of reproducing both classical and stall flutter. The minimum rotor speed for the occurrence of stall flutter in hover, was found to be determined from coupling between torsion and flapping. Instabilities analogous to both classical and stall flutter were found to occur in forward flight. However, the large stall-related torsional oscillations which commonly limit aircraft forward speed appear to be the response to rapid changes in aerodynamic moment which accompany stall and unstall, rather than the result of an aerelastic instability. The severity of stall-related instabilities and response was found to depend on some extent on linear stability. Increasing linear stability lessens the susceptibility to stall flutter and reduces the magnitude of the torsional response to stall and unstall.
AUTH: A/BALGERAK, J. C.; B/FELLER, R. F.
AVAIL: NTIS SAP: HC $8.25
MAJS: /AERODYNAMIC CHARACTERISTICS/AERODYNAMIC
CONFIGURATIONS/HELIICOPTERS/ROTORIAL WINGS/VORTICES
MINS: /AIR FLOW/ FLOW VISUALIZATION/ HELICOPTER PERFORMANCE
/PRESSURE DISTRIBUTION
ABA: Author
ABS: Test for wind tunnel was conducted to study the influence of sweep angle on the pressure distributions of an ogee tip configuration with relation to the effectiveness of the ogee tip in diffusion a line vortex. In addition to the pressure data, performance and flow-visualization data were obtained in the wind tunnel tests to evaluate the application of the ogee tip to aircraft configurations. The effect of sweep angle on the performance characteristics of a conventional tip model having equivalent planform area was also investigated for comparison with the ogee tip configuration. Results of the investigation generally indicate that sweep angle has little effect on the characteristics of the ogee in diffusion a line vortex.

74N11691 " ISSUE 2 PAGE 225 CATEGORY 2 73/10/00
17 PAGES UNCLASSIFIED DOCUMENT
UTTL: Helicopter visual aid system
AUTH: A/BAISLEY, R. L.
CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.
Symp., p 203-309 (SEE N 74-11667 02-31)
MAJS: /FLIGHT TESTS/HELIICOPTERS/SYSTEMS ENGINEERING/
VISUAL AIDS
MINS: /DISPLAY DEVICES/ IMAGING TECHNIQUES/ OPTICAL
EQUIPMENT/ STRUCTURAL DESIGN
ABA: Author
ABS: The helicopter visual aid system has been built and flight tested in situations representative of actual flight missions. The mechanisms developed contributed greatly to the successful performance of the system throughout the 160 hours of flight testing. It has demonstrated that the visual aid concept can provide improved daytime visual capability, greatly improved nighttime capability, surveillance from greater distances and/or altitudes, covert operation at night through the use of an IR searchlight, and a photographic recording at the scene being viewed.

74N10978 " ISSUE 2 PAGE 129 CATEGORY 5 RPT:
NASA CR-132347 CNT#: NASA-11222 73/12/07 89 PAGES
UNCLASSIFIED DOCUMENT
UTTL: Effects of helicopter noise and vibration on pilot performance (as measured in a fixed-base flight simulator)
AUTH: A/STAVE, A. M.
AVAIL: NTIS SAP: HC $8.50
MAJS: /AIRCRAFT NOISE/HELIICOPTERS/PILOT PERFORMANCE/
VIBRATION EFFECTS
MINS: /COMPUTERIZED SIMULATION/FLIGHT FATIGUE/ VERTICAL
TAKEOFF AIRCRAFT
ABA: Author
ABS: The effects of noise and vibration on pilot performance are described. Pilot subjects were required to fly VTOL commercial IFR schedules using the computer simulation facilities. The routes flown simulated closely metropolitan routes flown currently by a helicopter airline. The duration of simulator flights ranged from 3 to 8 hours. Subjects were exposed to noise sound pressure levels ranging from 74 to 77 dB (ambient) to 106 dB and 17 Hz vibration stimuli ranging from 0.1 g to 3 g measured at the floor directly beneath the pilot's seat. Despite subject reports of extreme fatigue in these long flights, performance did not degrade. A curve of performance shows a slow improvement for the first three hours of exposure and a slight loss in performance during the remainder of the flight. As environmental stress conditions (noise, vibration, and time in the simulator) increased, subject performance improved. Within the limits of this study, the higher the stress the better the performance.

73N31946 " ISSUE 23 PAGE 2741 CATEGORY 2 RPT:
NASA CR-114650 D6-60234 CNT#: NASA-6669 73/07/00
112 PAGES UNCLASSIFIED DOCUMENT
UTTL: Aircraft noise source and computer programs - User's guide
UNOC: Computer programs for predicting the noise-time histories and noise contours for five types of aircraft
AUTH: A/CREWLEY, K. C. B/FAJER, M. A. C/MELDURUM, D. F.
AVAIL: NTIS SAP: HC $7.75
MAJS: /AERODYNAMIC MEASUREMENT/AERODYNAMIC PROPERTIES/AIRCRAFT NOISE/COMPUTER PROGRAMS
MINS: /ENGINE NOISE/GAS TURBINES/ HELICOPTERS/ NUMERICAL
ANALYSIS/ V/STOL AIRCRAFT
ABA: Author
ABS: The application of computer programs for predicting the noise-time histories and noise contours for five
types of aircraft is reported. The aircraft considered are: (1) turbojet, (2) turbofan, (3) turboprop, (4) V/STOL, and (5) helicopter. Three principle considerations incorporated in the design of the noise prediction program are core effectiveness, limited input, and variable output reporting.

73N31945\# ISSUE 23 PAGE 2741 CATEGORY 2 RPT#: NASA-CR-114649 D6-60233 CNT#: NAS2-6969 73/07/00 233 PAGES UNCLASSIFIED DOCUMENT

UUTL: Aircraft noise source and contour estimation
UNOC: Calculation procedures for predicting noise-time histories and noise contours for various types of aircraft
AUTH: A/DOUKN, D. G.; B/PEART, N. A.
AVAIL NTIS: SAP: HC $13.75
MAJS: /AIRCRAFT NOISE/AIRCRAFT NOISE INTENSITY
MINS: /ENGINE NOISE/ HELICOPTERS/ TURBINE ENGINES/ V/STOL AIRCRAFT
ABA: Author

ABS: Calculation procedures are presented for predicting the noise-time histories and noise contours (footprints) of five basic types of aircraft: turbojet, turbofan, turboprop, V/STOL and helicopter. Tests procedures used to facilitate prediction of the noise characteristics during takeoffs, flyovers, and/or landing operations.

73N30948\# ISSUE 22 PAGE 2614 CATEGORY 2 RPT#: NASA-CR-112333 CNT#: NAS1-1168 73/06/00 138 PAGES UNCLASSIFIED DOCUMENT

UUTL: Application of composites to helicopter airframe and landing gear structures
AUTH: A/RICH, M. J.; B/RIDGELEY, G. F.; C/LOWRY, D. N.
CORP: United Aircraft Corp., Stratford, Conn. C5: Sikorsky Aircraft, Harris, Md.
AVAIL NTIS: SAP: HC $9.00
Sponsored in part by Army Air Mobility R and D Lab., Hampton, Va.
MAJS: /AIRCRAFT/AIRCRAFT/HELICOPTERS/AIRCRAFT STRUCTURES/COMPOSITE MATERIALS/HELICOPTERS/HELICOPTERS/LANDING GEAR
MINS: /PRODUCTION ENGINEERING/ QUALITY CONTROL/ SERVICE LIFE
ABA: Author

ABS: A preliminary design study has indicated that advanced composite helicopter airframe structures can provide significant system cost advantages in the 1980's. A seven percent increase in productivity and a five percent reduction in life cycle cost are projected. Due to their complexity, landing gear structures do not substantially benefit from the use of advanced composites. The most successful concept was found to be all-molded composite modular panels, which provide integral skin/stringer and frame subassemblies. These subassemblies significantly reduce the number of parts relative to present construction. The subassemblies are mechanically jointed together for economical, rapid final assembly and permit field replacement in the event of major damage.

73N30019\# ISSUE 21 PAGE 2494 CATEGORY 2 RPT#: NASA-TI-F-769 CNT#: NASW-2465 73/08/00 224 PAGES UNCLASSIFIED DOCUMENT

UUTL: Methods and techniques of airframe strength flight tests
UNOC: Analysis of flight test procedures for evaluating strength of airframes for aircraft and helicopters
AUTH: A/GUDKOV, A. I.; B/LESHAKOV, P. S.
CORP: Technol. Corp., Silver Spring, Md. AVAIL NTIS: SAP: HC $5.50
MAJS: /AIRCRAFT/LANDING GEAR/FLIGHT TESTS/STRUCTURAL ANALYSIS/ FLIGHT TESTING/ STRUCTURAL STABILITY/ VIBRATION TESTS
MINS: /AIRCRAFT STRUCTURES/ AIRCRAFT PERFORMANCE/ DATA ACQUISITION/ RELIABILITY ANALYSIS/ SYSTEMS ENGINEERING
ABA: Author

ABS: Methods of flight tests for evaluating the strength of aircraft and helicopters are presented. The basic types of modern measurement equipment used for measuring vibrations, stresses, temperatures and other parameters are described and recommendations are given concerning the measurement and calibration of the equipment. Brief information on laboratory airframe tests is included. Methods of flight tests for strength in which loads and vibrations are measured are discussed. Methods of analyzing measurement data in terms of airframe load features are presented. The basic computer hardware used for processing and analyzing measurement results are described.
to blades.

AUTH: A/COSTES, J. J.
CORP: Kaman (Leo) Associates, Redwood City, Calif.
Navy, N.A.S. S.A.P: A.1. 3-5.
Washington, NASA Transl. into ENGLISH from La Rech.
Aerosp. (Paris), no. 2. 1972 p 91-106
MAGS: AERO DYNAMIC CHARACTERISTICS/* FORCE DISTRIBUTION/* HELICOPTER PERFORMANCE/ LIFT/ ROTARY WINGS
MINS: AERO DYNAMIC FORCES/APPLICATIONS OF MATHEMATICS/
NUMERICAL ANALYSIS
ABA: Author
ABS: Numerical methods for determining the unsteady aerodynamic forces on helicopter rotor blades are presented. The calculation of the velocity potential induced by a lifting surface element when its position, orientation, and lift are known is developed as a function of time. The collocation method makes it possible to express the lift distribution as a function of the velocity component normal to the blades on a network of collocation points distributed on the rotor disc. A comparison between theory and experiment in the case of forward flight is provided.

73N26481* ISSUE 17 PAGE 2037 CATEGORY 15
RPT#: NASA-CR-120983 SER-50776 CN#: NAS3-15864 73/07/00 78 PAGES UNCLASSIFIED DOCUMENT
ABU: Development of helicopter transmission seals. task 2
UNOC: Design, fabrication, and evaluation of helicopter transmission seals using dual element split ring and circumferential seal configurations
AUTH: A/HAYDEN, T. S.; B/KELLER, C. H., JR.
Navy, N.A.S. S.A.P: A.1. 3-5.0.00
Sponsored in part by the Army Air Ruptility R and D Lab.
MAGS: HELICOPTER PROPELLER DRIVE/PACKINGS (SEALS)
MINS: EQUIPMENT SPECIFICATIONS/ PERFORMANCE TESTS/ PRODUCT DEVELOPMENT
ABA: Author
ABS: High speed helicopter transmission seal concepts were designed, fabricated and tested. The concepts were dual element split ring seal and a circumferential seal. The tests were performed in a rig using an actual input quill assembly. The test conditions were selected to simulate transmission operation and were 230 F oil temperature, and a sliding speed of 9400 ft/min. The split ring seal exhibited gross leakage and was considered unsatisfactory, while the circumferential seal leakage was less than 1 c.c./hour; this leakage is within acceptable limits. The circumferential seal wear was only 0.005 inches during a 100 hour run (40 starts and stops). During a 40 hour contamination test (methyl silicone flour) the seal total wear was a maximum of 0.004 inches. This wear is considered acceptable.

73N25070* ISSUE 16 PAGE 1661 CATEGORY 2 RPT#: NASA-CR-114626 REPT-300-699-010 CN#: NAS3-73CB 73/05/16 135 PAGES UNCLASSIFIED DOCUMENT
ULTL: Full scale hover test of a 25 foot tilt rotor
UNOC: Full scale hover test of 25-foot tilt rotor
AUTH: A/HALF, S.; B/BROMLEY, E.; C/GAEFLER, S.; D/CHARLES, B.
CORP: Bell Helicopter Co., Fort Worth, Tex. N.A.S. S.A.P: A.1. 3-5.0.00
MAGS: FULL SCALE TESTS/HOVERING/TILT ROTOR RESEARCH AIRCRAFT PROGRAM/WIND TUNNEL TESTS
MINS: AERO DYNAMIC/ AIRCRAFT NOISE/ PERFORMANCE TESTS
ABA: Author
ABS: The tilt rotor underwent a hover performance test on the Aero Propulsion Laboratory whirl stand at Wright Patterson Air Force Base. The maximum thrust over density ratio measured at the design tip speed of 740 feet per second was 10.016 pounds. This occurred when the power over density ratio was 1721 horsepower. At the hover overhead, the thrust and power, over density ratio, were 11,008 pounds and 1666 horsepower. During the test, the maximum measured thrust coefficient was 0.177, and the rotor figure of merit exceeded 0.84. Measured lifting efficiency was 8.35 pounds per horsepower at the thrust the 13,000-pound aircraft would require for hover at sea level on a standard day. No effect of compressibility on performance is discernible in the test results (the range of tip Mach numbers tested was 0.55 to 0.71).

73N24071* ISSUE 16 PAGE 1725 CATEGORY 2 RPT#: NASA-CR-132553 SUDAAR-446 CN#: NAS3-5143 72/06/00 31 PAGES UNCLASSIFIED DOCUMENT
ULTL: Synthesis of hover autopilots for rotary-wing VTOL aircraft
UNOC: Synthesis of hover autopilots for rotary wing VTOL aircraft
AUTH: A/HALL, W. E.; B/BRYSON, A. E.,JR.
CORP: Stanford Univ., Calif. CSS: (Guidance and Control Lab.) N.A.S. S.A.P: A.1. 3-5.0.00
MAGS: AUTOMATIC PILOTS/ROTARY WING AIRCRAFT/VERTICAL TAKE-OFF AIRCRAFT
MINS: DEGREES OF FREEDOM/HOVERING/MATHEMATICAL MODELS/ PITCH INCLINATION/ROTOR AERODYNAMICS/WIND EFFECTS
ABA: Author
ABS: The practical situation is considered where imperfect information on only a few rotor and fuselage state variables is available. Filters are designed to estimate all the state variables from noisy measurements of fuselage pitch/roll angles and from
noisy measurements of both fuselage and rotor pitch/roll angles. The mean square response of the vehicle to a very gusty, random wind is computed using various filter/controllers and is found to be quite satisfactory although, of course, not so good as when one has perfect information (idealized case). The second part of the report considers precision hover over a point on the ground. A vehicle model without rotor dynamics is used and feedback signals in position and integral of position error are added. The mean square response of the vehicle to a very gusty, random wind is computed, assuming perfect information feedback, and is found to be excellent. The integral error feedback gives zero position error for a steady wind, and smaller position error for a random wind.

73N21053: ISSUE 12 PAGE 1362 CATEGORY 2
UTUL: Fundamental Consideration of Noise Radiation by Rotary Wings
UNOC: Analysis of aerodynamic noise produced by rotary wings, and methods for noise reduction based on shed vortex wakes and blade tip modification
AUTH: A/LOwSON, W. V.
CORP: Loughboroug Univ. of Technology (England).
In AGARD Aerodyn. of Rotary Wings 18 p (SEE N73-21031 12-02) Sponsored by NASA and Natl. Gas Turbine Estab.
MAJS: /AERODYNAMIC NOISE/HELICOPTER WAKES/NOISE REDUCTION
MINS: /ACOUSTIC MEASUREMENT/AcouSTIC PROPERTIES/AERODYNAMIC CONFIGURATIONS/BLADE TIPS
ABA: Author

73N19984: ISSUE 10 PAGE 1258 CATEGORY 23
UTUL: Helicopter visual aid system
UNOC: Improved visual capability for police helicopters
AUTH: A/BASILEY, R. L.
MAJS: /HELICOPTERS/POLE/VISUAL FEEDBACK
MINS: /DISPLAY DEVICES/OPTICS/SEARCHLIGHTS/VISUAL OBSERVATION
ABA: Author

ABS: The results of an evaluation of police helicopter effectiveness revealed a need for improved visual capability. A JPL program developed a method that would enhance visual observation capability for both day and night usage and demonstrated the feasibility of the adopted approach. This approach made use of remote pointable optics, a display screen, a slaved covert searchlight, and a coupled camera. The approach was proved feasible through field testing and by judgment against evaluation criteria.

73N19014: ISSUE 10 PAGE 1105 CATEGORY 2 RPT#:
UTUL: Prediction of helicopter rotor loads
UNOC: Predicting loads and stresses on helicopter rotor blades
AUTH: A/GALLO, J.
AVAIL. N15 SAP: HC $3.00
MAJS: /HELICOPTER PERFORMANCE/PERFORMANCE PREDICTION/ROTOR WINGS
MINS: /AERODYNAMIC LOADS/AERODYNAMICS/STRESSES
ABA: Author

ABS: The correct design of a rotor requires a precise knowledge of the alternating loads to which blade and hub are submitted. The problem of the stress evaluation, from the early design stage, may lead to very sophisticated methods, because the blade is operating in a very complex environment. Nevertheless, simplified methods may give sufficiently precise results. The design of the elements of the rotor. The method described supposes simple aerodynamics, independent of blade elastic deformations. The degree of simplification achieved in
this theoretical method seems to be justified by the correlation obtained with experimental airloads measured on a model rotor at the Modane Wind Tunnel, and stresses recorded on the same rotor, or a full-scale semi-articulated rotor.

73N18956# ISSUE 10 PAGE 1103 CATEGORY 1 RPT#: NASA-CR-2225 CNT#: NAS1-11049 73/03/00 94 PAGES UNCLASSIFIED DOCUMENT

UTTL: Analysis of helicopter maneuver-loads and rotor-loads test data
UNOC: Analysis of airloads and blade response of rotary wings to determine sources of rotor vibratory loads in level and maneuvering flight of NH-3A and CH-53A helicopters
AUTH: A/BENO. E. A.
CORP: United Aircraft Corp., Stratford, Conn. CSS: ( Sikorsky Aircraft Div.) AVAIL.NTIS SAP: HC $3.00 Washington NASA
MAJS: /AERODYNAMIC LOADS/H-53 HELICOPTER/STRESS ANALYSIS
MINS: /AERODYNAMIC CONFIGURATIONS/HELICOPTER PERFORMANCE/ROTARY WINGS/VIBRATION MEASUREMENT
ABA: Author
ABS: A study was conducted in which available airloads and blade response data for the NH-3A and CH-53A rotors were analyzed in an attempt to provide further insight into the sources of rotor vibratory loads in both level and maneuvering flight. Primary emphasis in this study was placed on examining and understanding causes of high-frequency rotor critical loads. Secondary objectives were: (1) to examine the effect of number of rotor blades on hub vibratory shear forces and (2) to assess which of the many terms appearing in the hub vibratory shear force expression were of most significance.

73N18035# ISSUE 9 PAGE 984 CATEGORY 2 RPT#: NASA-CR-114562 CNT#: NAS2-5168 72/09/00 2 VOLS 72 PAGES UNCLASSIFIED DOCUMENT

UTTL: Vibration and loads in hingeless rotors. Volume 2: Experimental data
UNOC: Descriptions, geometry, and technical data for three rotary wing systems used in determining vibration and loads in hingeless rotary wings - Vol. 2
AUTH: A/WATTS, G. A.; B/LONDON, R. J.
CORP: Lockheed-California Co., Van Nuys, CSS: (Rotary Wing Div.) AVAIL.NTIS SAP: HC $15.75 Sponsored in part by Army Air Mobility Res. and Develop. Lab.
MAJS: /HELIQUOPTER PROPELLER DRIVE/RIGID ROTORS/ROTARY WINGS/VIBRATION EFFECTS
MINS: /AERODYNAMIC CHARACTERISTICS/BENDING MOMENTS/HARMONIC EXCITATION/NUMERICAL ANALYSIS
ABA: Author
ABS: Analytical methods are developed for calculating blade loads and shaft-transmitted vibratory forces in stiff bladed hingeless rotors operating at advance ratios from $\mu = .3$ to $\mu = 2.0$. Calculated shaft harmonic moments compared well with experimental values when the blade first flap frequency was in the region of two-per-revolution harmonic excitation. Calculated blade bending moment and hoop distributions due to changes in cyclic pitch agreed well with experiment at radii stations near the blade root at values of the ratio of first flap frequency to rotor rotation rate from 1.5 to 5.0. At stations near the blade tip good agreement was only obtained at the higher values of frequency ratio.
The nonlinear flap lag coupled oscillation of torsionally rigid rotor blades in forward flight is examined using a set of consistently derived equations by the asymptotic expansion procedure of multiple timescales. The regions of stability and limit cycle oscillation are presented. The roles of parametric excitation, nonlinear oscillation, and forced excitation played in the response of the blade are determined.

Equations of motion are used to investigate the effects of the choice of the mode shape and building-in-coning angle on the stability boundaries of hingeless blades in hover. The results obtained indicate that the stability boundaries are dependent upon the mode shape to a considerable degree. It was also found that positive building-in-coning is usually destabilizing while a negative amount of building-in-coning can be quite stabilizing.

Effects of aerodynamic stall on helicopter rotor blade elements in three-dimensional rotating environments are presented. The theory takes account of the vortex wake geometry for nonuniform flow through the rotor disc as well as the effect of rolling up and contraction of free tip- and root-vortices. Calculating the blade circulation distribution requires careful attention to the case where the blades pass through the rolled-up tip- and root-vortex of the foregoing foil.
A traverse mechanism which allows the measurement of the three dimensional boundary layers on a helicopter rotor blade has been built and tested on a full scale rotor to full scale conditions producing centrifugal accelerations in excess of 400 g and Mach numbers of 0.6 and above. Boundary layer velocity profiles have been measured over a range of rotor speeds and blade collective pitch angles. A pressure scanning switch and transducer were also tested on the full scale rotor and found to be insensitive to centrifugal effects within the normal main rotor operating range. The demonstration of the capability to measure boundary layer behavior on helicopter rotor blades represents the first step toward obtaining, in the rotating system, data of a quality comparable to that already existing for flows in the fixed system.

A new performance measure is introduced for multivariable closed loop experiments with a human operator. The essential feature of the phase margin performance measure (PMP) is that the performance of each control loop can be determined independently, with prescribed disturbance and error levels. A variable filter parameter is used as the PMP within the loop and it assures a high workload at the same time. There is a straightforward relationship between the PMP and the inner loop resonant augmentation that can be utilized in trade-off studies. An adjustment scheme that seeks the PMP automatically is formulated as employed in a single loop control task. This task applies directly to the experimental study of displays for helicopters and VTOL aircraft.

A mathematical model and computer program was implemented to study the main rotor free wake geometry effects on helicopter rotor blade air loads and response in steady maneuvers. Volume 1 (NASA CR-2110) contains the theoretical formulation and analysis of results. Volume 2 contains the computer program listing.
compared with pilot ratings. The results show reasonable agreement between pilot and passenger. Subjective comfort levels obtained for mixed frequency environments clearly demonstrate the need for a multi-frequency criterion.

72N10015* ISSUE 1 PAGE 3 CATEGORY 2 72/10/00 16 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Ride quality criteria for large commercial helicopters
UNOC: Application of ride-quality criteria to design of commercial helicopters with emphasis on noise and vibration considerations
AUTH: E. SCHLEGEL, R. G.; B. STAVE, A. M.; C. WOLF, A. A.
NAMA: In NASA Langley Res. Center Symp. on Vehicle Ride Quality p 51-66 (SEE: 73-1002 01-02)
MINS: \AERODYNAMIC NOISE/\HELICOPTER DESIGN/\HUMAN FACTORS ENGINEERING/VIBRATION EFFECTS
COMFORT/PHYSIOLOGICAL EFFECTS/PSYCHOLOGICAL EFFECTS/SAFETY FACTORS
ABA: Author
ABS: A review of major ride-quality criteria used in the design of commercial helicopters. The limitations of these criteria are examined and recommendations for further research are made.

72N33021* ISSUE 24 PAGE 3167 CATEGORY 2 RPT#: NASA-CR-112157 CNT#: NASI-11251 72/00/00 197 PAGES UNCLASSIFIED DOCUMENT

UTILITY: A conceptual study of the rotor systems research aircraft
UNOC: The comparison of two helicopter design concepts developed to conduct rotary wing research project
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL NTIS SAP: MC $12.00
MINS: \AERODYNAMIC CHARACTERISTICS/\AIRCRAFT STABILITY/\COMPOUND HELICOPTERS/HELICOPTER DESIGN
ABA: Author
ABS: The conceptual design of a compound helicopter for conducting rotor research is presented. The aircraft was selected by the Government as the better of two concepts submitted. The helicopter is capable of operation in the 25,000 pound gross weight class. It has been determined that the helicopter satisfies the requirements for the rotor research mission. The model has been designed to allow an assessment of its performance and stability characteristics. A brief treatment of these subjects is included.

72N33017* ISSUE 24 PAGE 3167 CATEGORY 2 RPT#: NASA-CR-112155 SER-50775-4 CNT#: NASI-11228 72/10/06 63 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Rotor systems research aircraft predesign study
UNOC: Preliminary design study of the rotor systems research aircraft for flight testing advanced helicopter and compound rotor systems
AUTH: A MILLER, A. N.; B. LINDEN, A. W.
ABA: Author
ABS: The analytical comparison of the two candidate Rotor Systems Research Aircraft (RSRA) configurations selected by the Government at the completion of Part 1 of the RSRA Conceptual Predesign Study is presented. The purpose of the comparison was to determine the relative suitability of both vehicles for the RSRA mission described in the Government Statement of Work, and to assess their versatility in the testing of new rotor concepts. The analytical comparison was performed primarily with regard to performance and stability and control. A weights, center-of-gravity, and inertial computation was performed for each of the two vehicles but explored the dynamic problems attending operation of any rotorcraft operating with large rotor RPM and diameters ranging over a wide speed range. Several means of isolating in- and out of plane rotor vibrations were analyzed. An optimum isolation scheme was selected.

72N33000* ISSUE 24 PAGE 3167 CATEGORY 2 RPT#: NASA-CR-112156 CNT#: NASI-11251 72/00/00 83 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Predesign report for the rotor systems research aircraft
UNOC: Design, development, and aerodynamic characteristics of the compound helicopter designed for rotor systems research applications
CORP: Bell Helicopter Co., Fort Worth, Tex. AVAIL NTIS SAP: MC $6.25
MINS: \AERODYNAMIC CHARACTERISTICS/\COMPOUND HELICOPTERS/HELICOPTER DESIGN/ROTARY WINGS
ABA: Author
ABS: A conceptual predesign of a compound helicopter for conducting rotor research is presented. The aircraft was selected by the Government as the better of two concepts submitted. The helicopter is capable of operation in the 25,000 pound gross weight class. It has been determined that the helicopter satisfies the requirements for the rotor research mission. The model has been designed to allow an assessment of its performance and stability characteristics. A brief treatment of these subjects is included.
MAJS: /AIRCRAFT DESIGN/*FLIGHT TEST VEHICLES/*RESEARCH
AIRCRAFT/*ROTARY WINGS
MINS: /AERODYNAMIC CONFIGURATIONS/ AIRFRAMES/ HELICOPTERS/
SPECIFICATIONS/ SYSTEMS ANALYSIS
ABA: D.L.G.
ABS: The RSRA requirements are presented in a detailed
specification format. Coverage of the requirements
includes the following headings: (1) aircraft
characteristics, (2) general features of design and
construction, (3) aerodynamics, (4) structural design
criteria, (5) flight control system, (6) propulsion
subsystem, and (7) secondary power and distribution
subsystem.

72N33016# ISSUE 24 PAGE 3166 CATEGORY 2 RPT:
NASA-CR-112154 SER-50775-VOL-3 CN#: NASA-1122B
72/10/06 186 PAGES UNCLASSIFIED DOCUMENT
UTTL: Rotor systems research aircraft predesign study.
Volume 3: Predesign report
UNOC: Design of rotor system research aircraft for flight
testing advanced helicopter and compound rotor systems
- Vol. 3 - TLSP: Final Report
AUTH: A/SCHMIDT, S. A.; B/LINDEH, A. W.
CORP: United Aircraft Corp., Stratford, Conn. CSS:
(Aviation Aircraft Div.) AVAIL.NTIS SAP: HC $11.50
MAJS: /AIRCRAFT DESIGN/*FLIGHT TEST VEHICLES/*RESEARCH
AIRCRAFT/*ROTARY WINGS
MINS: /AERODYNAMIC CONFIGURATIONS/ AIRFRAMES/ HELICOPTERS/
PERFORMANCE PREDICTION/ SYSTEMS ENGINEERING
ABA: Author
ABS: The overall feasibility of the technical requirements
and concepts for a rotor system research aircraft
(RSRA) was determined. The designs of two aircraft
were then compared against the RSRA requirements.
One of these is an all new aircraft specifically designed
for an RSRA vehicle. A new main rotor, transmission,
wings, and fuselage are included in this design.
The second aircraft uses an existing Sikorsky S-61 main
rotor, an S-61 roller gearbox, and a highly modified
Sikorsky S-67 airframe. The wing for this aircraft is
a new design. Both aircraft employ a fan-in-fan
anti-torque/swing control system. 158-GE-16 engines for
power rotor, and TF34-GE-2 turbofans for auxiliary
thrust. Each aircraft meets the basic requirements and
goals of the program. The all new aircraft has
inherent variable main rotor shaft tilt, a
side-by-side cockpit seating arrangement, and is
slightly faster in the compound mode. It is also
somewhat lighter since it uses new dynamic components
specifying designed for the RSRA. Preliminary
development plans, including schedules and costs, were
prepared for both of these aircraft.

72N33014# ISSUE 24 PAGE 3166 CATEGORY 2 RPT:
NASA-CR-112152 SER-50775-VOL-1 CN#: NASA-1122B
72/10/06 2B PAGES UNCLASSIFIED DOCUMENT
UTTL: Rotor systems research aircraft of Predesign study.
Volume 1: Summary and conclusions
UNOC: Design of rotor system research aircraft for flight
testing advanced helicopter and compound rotor systems
- Vol. 1 - TLSP: Final Report
AUTH: A/LINDEH, A. W.
CORP: United Aircraft Corp., Stratford, Conn. CSS:
(Aviation Aircraft Div.) AVAIL.NTIS SAP: HC $3.50
MAJS: /AIRCRAFT DESIGN/*FLIGHT TEST VEHICLES/*RESEARCH
AIRCRAFT/*ROTARY WINGS
MINS: /AERODYNAMIC CONFIGURATIONS/ AIRFRAMES/ HELICOPTERS/
PERFORMANCE PREDICTION/ SYSTEMS ENGINEERING
ABA: Author
ABS: The features of two aircraft designs were selected to
be included in the single RSRA configuration. A study
was conducted for further preliminary design and a
more detailed analysis of development plans and costs.
An analysis was also made of foreseeable technical
problems and risks, identification of parallel
research which would reduce risks and/or add to the
basic capability of the aircraft, and a draft aircraft
specification.

72N33015# ISSUE 24 PAGE 3166 CATEGORY 2 RPT:
72/10/06 6B PAGES UNCLASSIFIED DOCUMENT
UTTL: Rotor systems research aircraft predesign study.
Volume 2: Conceptual study report
UNOC: Design of rotor system research aircraft for flight
testing advanced helicopter and compound rotor systems
- Vol. 2 - TLSP: Final Report
AUTH: A/SCHMIDT, S. A.; B/LINDEH, A. W.
CORP: United Aircraft Corp., Stratford, Conn. CSS:
(Sikorsky Aircraft Div.) AVAIL.NTIS SAP: HC $5.50
MAJS: /AIRCRAFT DESIGN/*FLIGHT TEST VEHICLES/*RESEARCH
AIRCRAFT/*ROTARY WINGS
MINS: /AERODYNAMIC CONFIGURATIONS/ AIRFRAMES/ HELICOPTERS/
PERFORMANCE PREDICTION/ SYSTEMS ENGINEERING
ABA: Author
ABS: The results are summarized of a study to develop a
versatile research aircraft for flight testing a wide
variety of advanced helicopter and compound rotor
systems. The aircraft is required to accommodate these
rotors with minimal changes in the basic vehicle.
Rotors envisioned for testing include conventional
rotors plus variable geometry, variable pitch,
variable diameter, coaxial, jet flaps, circulation
control, and slowed rotors. Various disc loadings
would be accommodated. The aircraft must be configured
to measure performance more accurately than past test vehicles. In addition, the aircraft would have a wing to off load the rotor while measuring performance during lightly loaded conditions. It would have variable drag and propulsive force so that the rotor can be tested while producing different values of horizontal force.

AUTH: A/SADLER, S. G.
AVAIL. NTIS: SAP: HC $3.00
WASHINGTON NASA
MAJS: /AERODYNAMIC LOADS/HELICOPTER PERFORMANCE/
HELICOPTER WAKES/ROTARY WINGS
MINS: /AERODYNAMIC CHARACTERISTICS/ COMPUTER PROGRAMS/
NUMERICAL ANALYSIS
ABA: Author
ABS: A mathematical model and computer program were implemented to study the main rotor free wake geometry effects on helicopter rotor blade air loads and response in steady maneuvers. The theoretical formulation and analysis of results are presented.

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folded, and fully folded configurations. During the tests the rotor completed over forty start/stop sequences. After completing the sequences in a stepwise manner, smooth start/stop transitions were made in approximately two seconds. Wing tunnel speeds up through seventy-five knots were used, at which point the rotor mast angle was incremented to four degrees, corresponding to a maneuver condition of one and one-half g.

AUTH: A/HOHLHAUSER, W. L.; B/MAYNER, R. D.
CORP: National Transportation Safety Board, Washington, D. C.
IN NASA: Langley Res. Center Advanced Approaches to Fatigue Evaluation / SEE N72-29895 20-32/
/AIRCRAFT ACCIDENTS/CIVIL AVIATION/FAILURE ANALYSIS/
+FATIGUE (MATERIALS)
MINS: / INSPECTION/ MAINTENANCE/ RELIABILITY ENGINEERING/
STRUCTURAL FAILURE
ABA: Author
ABS: A review of records maintained by the National Transportation Safety Board showed that 16.054 civil aviation accidents occurred in the United States during the 3-year period ending December 31, 1969. Material failure was an important factor in the cause of 942 of these accidents. Fatigue was identified as the mode of the material failures associated with the cause of 155 accidents and in many other accidents the records indicated that fatigue failures might have been involved. There were 27 fatal accidents and 157 fatalities in accidents in which fatigue failures of metal components were definitely identified. Fatigue failures associated with accidents occurred most frequently in landing-gear components, followed in order by propeller, and structural components in fixed-wing aircraft and tail-rotor and main-rotor components in rotorcraft. In a study of 230 laboratory reports on failed components associated with the cause of accidents, fatigue was identified as the mode of failure in more than 60 percent of the failed components. The most frequently identified cause of fatigue, as well as most other types of material failures, was improper maintenance (including inadequate inspection). Fabrication defects, design deficiencies, defective material, and abnormal service damage also caused many fatigue failures. Four case histories of major accidents are included in the paper.
as illustrations of some of the factors involved in fatigue failures of aircraft components.

72N29900+ ISSUE 20 PAGE 2760 CATEGORY 32
72/00/00 17 PAGES UNCLASSIFIED DOCUMENT
UTT: The practical implementation of fatigue requirements to military aircraft and helicopters in the United Kingdom
UNOC: Fatigue requirements for ensuring structural integrity of military aeroplanes and helicopters
AUTH: A/MAXWELL, R. D. J.
CORP: Royal Aircraft Establishment, Farnborough (England).
MAJ: /AIRCRAFT DESIGN/AIRCRAFT RELIABILITY/FATIGUE LIFE
/MILITARY AIRCRAFT/MILITARY HELICOPTERS
MINS: /AIRCRAFT STRUCTURES/ LOADS (FORCES) SERVICE LIFE/
SPECIFICATIONS
ABA: Author
ABS: The methods adopted in the United Kingdom to ensure the structural integrity of military aeroplanes and helicopters from the fatigue point of view are described. The procedure adopted from the writing of the specification to the monitoring of fatigue life in service are presented along with the requirements to be met and the way in which they are satisfied. Some of the outstanding problems that remain to be solved are indicated.

72N99262+ ISSUE 20 PAGE 2668 CATEGORY 12
RPT#: NASA-CR-112129 ASR-TR-153-1 CNT#: NGR-22-009-303 70/01/00 34 PAGES UNCLASSIFIED DOCUMENT
UTT: Leading-edge pressure measurements of airfoil vortex interaction
UNOC: Experimental pressure-differential measurements made at 10 percent chord of airfoil-vortex interaction
AUTH: A/WALSH, R. G., JR.
CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Aeroelastic and Structures Research Lab.) AVAL. NTIS SAP: HC $3.75
MAJ: /AERIOLE/S/PRESSURE MEASUREMENT/VORTICES
MINS: FREE FLOW LEADING EDGES, ROTARY WING AIRCRAFT/VEL
ABA: Author
ABS: Experimental pressure-differential measurements made at 10X chord of an airfoil-vortex interaction are presented. A line vortex was oscillated over an airfoil perpendicular to the span and parallel to the chord. The pressure time history was recorded in order to show the sharp pressure pulses resulting from the bursting of the vortex core as it impinges upon the airfoil. Results for various vortex sizes and free stream velocities were obtained. Measurements were also made when the airfoil was yawed to the line vortex. Maximum pressure differences were observed to occur in phase across the blade even with yaw, and were directly proportional to the square of the free stream velocity. The maximum dynamic pressure coefficients obtained were as high as 1.0 when vortex bursting occurred.

72N28002+ ISSUE 20 PAGE 2504 CATEGORY 2
RPT#: NASA-CR-112030 CNT#: NAS1-10365 72/05/00 96 PAGES UNCLASSIFIED DOCUMENT
UTT: A performance application study of a jet-flap helicopter rotor
UNOC: Application of jet-flap to reaction drive rotor for heavy lift high speed helicopter
AUTH: A/SULLIVAN, R. J.; B/LAFORGE, S.; C/HOLCHIN, B. W.
CORP: Hughes Tool Co., Culver City, Calif. CSS: (Aircraft Div.) AVAIL NTIS SAP: HC $7.00
construction of the rotor system. (3) principles of measurement for the structural stability of the rotor system, and (4) the operating test plan for the test blade. Engineering drawings of the helicopter systems and stress diagrams resulting from the tests are included.

72N28000* ISSUE 19 PAGE 2504 CATEGORY 2 RPT#: NASA-TT-F-14282 CNT#: NASW-2037 72/05/00 29 PAGES UNCLASSIFIED DOCUMENT

UTTL: Dynamic testing of helicopter components
UNOC: Application of dynamic component testing for development of helicopters to show test planning and execution
AUTH: A/SCHUMACHER, H.
CORP: Techtran Corp., Glen Burnie, Md. AVAIL NTIS SAP: HC $3.50
Washington NASA Conf. held in Ulmenstäd. West Ger.,
MAJS: /AIRCRAFT EQUIPMENT/HELICOPTER DESIGN/PERFORMANCE TESTS/STRUCTURAL DESIGN
MINS: /AIRCRAFT PARTS/EQUIPMENT SPECIFICATIONS/MATERIALS TESTS

ABA: Author
ABS: The importance of dynamic component testing for the development of helicopters is presented. Using the development of the BO 105 as an example, the test planning and execution used demonstrate the multiplicity and range of the test purposes. Various tests are presented in a series of figures for clarification.

72N27999* ISSUE 19 PAGE 2504 CATEGORY 2 RPT#: NASA-CR-112071 NASA-72-01 CNT#: NASI-11216 72/02/00 135 PAGES UNCLASSIFIED DOCUMENT

UTTL: Blade frequency program for nonuniform helicopter rotors, with automated frequency search
UNOC: Computer program for determining natural frequencies and normal modes existing in helicopter rotary wings
TLP#: INFOTAL Final Report
AUTH: A/SADLER, S. G.

MAJS: /HELICOPTERS/ROTARY WINGS/STRESS ANALYSIS/* STRUCTURAL ANALYSIS
MINS: /COMPUTER PROGRAMS/ ELASTIC PROPERTIES/VIBRATION EFFECTS

ABA: Author
ABS: A computer program for determining the natural
frequencies and normal modes of a lumped parameter model of a rotating, twisted beam, with nonlinear mass and elastic properties was developed. The program is used to solve the conditions existing in a helicopter rotor where the outboard end of the rotor has zero forces and moments. Three frequency search methods have been implemented. Including an automatic search technique, which allows the program to find up to the fifteen lowest natural frequencies without the necessity for input estimates of these frequencies.

72N24993# ISSUE 16 PAGE 2095 CATEGORY 1 RPT#: NASA-TT-F-14283 DLR-MITT-70-01 CN#: NAS-2035
72/05/00 32 PAGES UNCLASSIFIED DOCUMENT

UTTL: Evaluation of flight measurements and plotting of load cycles

UNOC: Applications of computers for flight test and evaluation of helicopters based on frequency analyses of load curves on main and tail rotors

AUTH: A/STREHLOW, H.; B/MIHALCEA, N.
CORP: Scientific Translation Service, Santa Barbara, Calif.

AVAIL.NTIS SAP: HC $3.75


MAJS: /COMPUTER PROGRAMS/*DATA PROCESSING EQUIPMENT/*FLIGHT TESTS/*HELICOPTERS

MINS: /AERODYNAMIC LOADS/* NUMERICAL ANALYSIS/* ROTARY WINGS/* VIBRATION TESTS

ABA: Author

ABS: The practical application of computers to the development and flight testing of helicopters is discussed. By classifying the dynamic stresses and establishing the spectral power density of measured vibration curves, load collective and damage criteria are established. Potential applications in the solution of various serviceability problems are described. The evaluation methods used and the necessity of employment of electronic data processing equipment are explained.

72N24531# ISSUE 15 PAGE 2033 CATEGORY 15 RPT#: NASA-TT-F-14280 CN#: NAS-2035 72/05/00 77 PAGES UNCLASSIFIED DOCUMENT

UTTL: Determination of the lifetime of helicopter components

UNOC: Development of methods for determining lifetime of helicopter components based on working stress and stress-time functions

AUTH: A/PRIEZ, R.
CORP: Scientific Translation Service, Santa Barbara, Calif.

AVAIL.NTIS SAP: HC $6.00

Washington NASA Translated into ENGLISH from Proc. of DGLR Symp. on Helicopters and Propellers, IMMENSTAAT, West Germany, 24 Jun. 1969

MAJS: /HELICOPTERS/*ROTOR WINGS/*SERVICE LIFE/*STRESS ANALYSIS

MINS: /PERFORMANCE PREDICTION/*RELIABILITY ENGINEERING/*STATISTICAL ANALYSIS

ABA: Author

ABS: Methods which are used, or are to be used in the future, for determining the lifetime of helicopter components are discussed. These methods are based on the determination of the working stress. Calculated or measured stress-time functions are studied; and both analytical and experimental methods are given for the statistical evaluation of these functions. The use of a unit collective for fatigue studies on rotor blades is also recommended, on the basis of various stress-collectives reported in the bibliography. This unit collective can serve as the basis for fatigue studies. Some possibilities for carrying out fatigue studies are stated, and the necessity for statistical evaluation of test results is mentioned. Some methods for determining lifetime on the basis of the fluctuating stresses are presented.

72N24105# ISSUE 15 PAGE 1666 CATEGORY 2 RPT#: NASA-CR-2043 D-210-10392-1 CN#: NAS-1-1004
72/06/00 90 PAGES UNCLASSIFIED DOCUMENT

UTTL: Acceptability of VTOL aircraft noise determined by absolute subjective testing

UNOC: Acceptability of VTOL aircraft noise determined by test subjects evaluating simulated sounds of helicopter, tilt wing aircraft, and turbojet aircraft

AUTH: A/STERNFIELD, H., JR.; B/HINTERUESSER, E. G.; C/HACKMAN, R. B.; D/DAVIS, J.
CORP: Boeing Co., Philadelphia, Pa. CSS: (Vertol Div.)

AVAIL.NTIS SAP: HC $3.00

Washington NASA

MAJS: /ACOUSTIC MEASUREMENT/*AIRCRAFT NOISE/*HUMAN TOLERANCES/*VERTICAL TAKEOFF AIRCRAFT

MINS: /HELICOPTERS/*JET AIRCRAFT/*PHYSIOLOGICAL TESTS/* SIMULATION/* TILT WING AIRCRAFT

ABA: Author

ABS: A program was conducted during which test subjects evaluating the simulated sounds of a helicopter, a tilt wing aircraft, and a 15 second 90 NdB (Lincoln) turbojet aircraft used as reference. Over 20,000 evaluations were made while the test subjects were engaged in work and leisure activities. The effects of level, exposure time, distance and aircraft design on subjective acceptability were evaluated. Some of the important conclusions are: (1) To be judged equal in annoyance to the reference jet sound, the helicopter
and tilt wing sounds must be 4 to 5 PNdB lower when lasting 15 seconds in duration. To be judged significantly more acceptable than the reference jet sound, the helicopter sound must be 10 PNdB lower when lasting 15 seconds in duration. To be judged significantly more acceptable than the reference jet sound, the tilt wing sound must be 12 PNdB lower when lasting 15 seconds in duration. The relative effect of changing the duration of a sound upon its subjectively rated annoyance diminishes with increasing duration. It varies from 2 PNdB per doubling of duration for intervals of 15 to 30 seconds, to 0.75 PNdB per doubling of duration for intervals of 120 to 240 seconds.

72N23024# ISSUE 14 PAGE 1827 CATEGORY 2 RPT#: NASA-TR-F-676 CR#: NASW-2035 72/05/00 292 PAGES UNCLASSIFIED DOCUMENT

UTL: Helicopter aerodynamics
UNOC: Principles of helicopter flight with emphasis on main rotor performance and aerodynamic forces imposed on helicopter during maneuvers
AUTH: A/BAZOV, D. I.
CORP: Scientific Translation Service, Santa Barbara, Calif.
AVAIL.NTIS: SAP: HC $3.00
MAJS: /AERODYNAMIC CHARACTERISTICS/AERODYNAMIC FORCES/HELIOTCER/PERFORMANCE
MINS: /AUTOROTATION/ HECIOTCER CONTROL/ HELICOPIER
ABA: Author
ABS: Two electrohydraulic vibration isolation systems were designed and fabricated to reduce the vertical vibrations transmitted to the OH-58A research helicopter (cabin at the blade passage frequency 118 Hz) and its first harmonic (35 Hz). Hydraulic power and electrical control are provided to two separate servoactuators from a common power supply and control electronics package located behind the pilot's seat. One servoactuator is installed between the cabin and fuselage and replaces an existing passive spring. A second servoactuator is mounted between the existing seat and cabin floor. Both servoactuators incorporate a mechanical failsafe design. The control electronics circuitry provides automatic tracking of the blade passage frequency. Results of laboratory environmental and ground vibration tests employing an OH-58A stripped down helicopter fuselage show that the active cabin isolator reduces the vertical vibrations transmitted from the fuselage attachment point to the cabin attachment point at 12.9 Hz to less than 50 percent.

72N19026# ISSUE 10 PAGE 1283 CATEGORY 2 RPT#: NASA-TR-1983 CR#: NGR-52-025-002 72/03/00 71 PAGES UNCLASSIFIED DOCUMENT

UTL: Helicopter noise: Blade slap. Part 2: Experimental results
UNOC: Flight tests to determine characteristics of blade slap in rotary wings and effect on helicopter performance
AUTH: A/LEVERTON, J. W.
CORP: Southampton Univ. (England), CSS: (Inst. of Sound and Vibration Research.) AVAIL.NTIS Washington, NASA
MAJS: /AERODYNAMIC NOISE/*FLIGHT TESTS/HELIOTCER PERFORMANCE/ROTARY WINGS
Blade slap encountered in rotary wings and its effect on helicopter performance are reported. The results of various individual flight tests are presented and, where possible, correlated with one another. Observations from the subjective evaluation of blade slap are included, together with a modified form of the blade slap factor (BSF) which can be used as a design criteria.
+/VORTICES

MINS: /DYNAMIC LOADS/ FLOW VELOCITY/ PRESSURE GRADIENTS/
TRAILING EDGES

ABA: E.H.W.

ABS: Several aspects of the aerodynamics of rotor blade tip vortices are examined. Two particular categories are dealt with: (1) dynamic loads on a blade passing close to or intersecting a trailing vortex, and (2) the response of the trailing vortex core to changes in the flow. Results for both categories are in reasonable agreement with existing data, although lower pressure gradients were obtained than anticipated for category one. A correlation between trailing edge sweep angle at the tip and vortex core size was noted for category two.

72N12988* ISSUE 4 PAGE 430 CATEGORY 2 RPT#:
NASA-CR-1883 CNT#: NAS1-9257 7/10/00 147 PAGES
UNCLASSIFIED DOCUMENT

UTIL: An evaluation of methods for assessing aircraft noise perception

UNOC: Accuracy of aircraft noise rating procedure relative to perceived sound levels

AUTH: A/OLLERHEAD, J. B.
CORP: Nyle Labs. Inc., Hampton, Va. AVAIL.NTIS
Washington NASA

MAJS: /AIRCRAFT NOISE/EFFECTIVE PERCEIVED NOISE LEVELS/
NOISE INTENSITY/PSYCHOACOUSTICS
MINS: /ACOUSTIC MEASUREMENT/AUDITORY STIMULI/RATINGS/
SOUND WAVES

ABA: Author

ABS: One hundred and twenty recorded sounds, including jets, turboprops, piston engine aircraft, and helicopters were rated by a panel of subjects in a paired comparison test. The results were analyzed to evaluate a number of noise rating procedures in terms of their ability to accurately estimate both relative and absolute perceived noise levels. It was found that the complex procedures developed by Stevens, Zwicker and Kryter are superior to other scales. The main advantage of these methods over the more convenient weighted sound pressure level scales lies in their ability to cope with signals over a wide range of bandwidth. However, Stevens' loudness level scale and the perceived noise level scale both overestimate the growth of perceived level with intensity because of an apparent deficiency in the band level summation rule. A simple correction is proposed which will enable these scales to properly account for the experimental observations.

71N37593* ISSUE 24 PAGE 3871 CATEGORY 1 RPT#:
NASA-CR-114362 CNT#: NAS2-5168 7/10/00 312 PAGES
UNCLASSIFIED DOCUMENT

UTIL: Trim, control, and stability of a gyro-stabilized heli-gees rotor at high advance ratio and low rotor speed

UNOC: Development of methods for measuring and predicting behavior of rigid rotors with stiff blades at high advance ratios and low rotor speeds

AUTH: A/WATTS, G. A.; B/LODGEN, R. J.
CORP: Lockheed-California Co., Van Nuys. CSS: (Rotary Wing Div.) AVAIL.NTIS

MAJS: /AERODYNAMIC CHARACTERISTICS/PERFORMANCE PREDICTION
/RIGID ROTORS/ROTARY WINGS
MINS: /HELICOPTER CONTROL/HELICOPTER DESIGN/HELICOPTER PERFORMANCE

71N37593* ISSUE 24 PAGE 3871 CATEGORY 1 RPT#:
NASA-TT-F-13988 CNT#: NASW-2035 7/10/00 49 PAGES
UNCLASSIFIED DOCUMENT

UTIL: Review of testing techniques for transonic airfoils

UNOC: Two dimensional flow tests of transonic airfoils

AUTH: A/BAZIN, M.
CORP: Scientific Translation Service. Santa Barbara, Calif. AVAIL.NTIS

MAJS: /AIRFOILS/TRANSONIC SPEED/THREE DIMENSIONAL FLOW
MINS: /HELICOPTERS/ROTARY WINGS/WALL FLOW/WIND TUNNELS

71N35210* ISSUE 22 PAGE 3539 CATEGORY 2 RPT#:
NASA-CR-114339 CNT#: NAS2-5572 7/06/00 376 PAGES
UNCLASSIFIED DOCUMENT

UTIL: Technology assessment of advanced general aviation aircraft

UNOC: Potential impact of advanced technology in 1985 on four types of general aviation aircraft including STOL VSTOL, and helicopters TILP Final Report

AUTH: A/HURKAMP, C. H.; B/JOHNSTON, W. M.; C/KILSON, J. H.
CORP: Lockheed-Georgia Co., Marietta. CSS: (Advanced Concepts Dept.) AVAIL.NTIS SAP: HC $6.00/MF $0.95

MAJS: /GENERAL AVIATION AIRCRAFT/HELICOPTERS/SHORT TAKEOFF AIRCRAFT/TECHNOLOGY ASSESSMENT
MINS: /AERODYNAMICS/ AIRCRAFT SAFETY/ COST ESTIMATES
PRINT 23/2/2409-2238 TERMINAL 20

82A26620* ISSUE 11 PAGE 1754 CATEGORY 37 CN#: NSR-1592 81/11/00 15 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Nonlinear vibration suppression using simple pendulum absorbers on the rotor blade
AUTH: HAMADOU, M.-N. H.; PIERCE, G. A.; PAAS
CORP: Georgia Institute of Technology, Atlanta, GA


MAJORS: AERO DYNAMICS/HELICOTER DESIGN/PENDULUM/ROTARY WINGS/VIBRATION DAMPING/VIBRATION ISOLATORS
MINS: DEGREES OF FREEDOM/FREQUENCY RESPONSE/HARMONIC ANALYSIS/HUBS/MATRICES (MATHEMATICS)/ROTOR AERODYNAMICS/WHIT LOADING

ABA: C.R

ABS: A design procedure is presented for the installation of simple pendulums on the blades of a helicopter rotor to suppress the root reactions. The procedure consists of a frequency response analysis for a hingeless rotor blade excited by a harmonic variation of spanwise airload distributions during forward flight, as well as a concentrated load at the tip. The structural modeling of the blade provides for elastic degrees of freedom in flap and lead-lag bending plus torsion. Simple flap and lead-lag pendulums are considered individually. Using a rational order scheme, the general nonlinear equations of motion are linearized. A quasi-steady aerodynamic representation is used in the formation of the airloads. The solution of the system equations derives from their representation as a transfer matrix. The results include the effect of pendulum tuning on the minimization of the hub reactions.

82A17851* ISSUE 6 PAGE B14 CATEGORY B RPT: AIAA PAPER 82-0242 CN#: NASP-1077 82/01/00 10 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Dynamic stability of a buoyant quad aircraft - for airlifting payloads externally on a sling
AUTH: KAYABUHAN, B. L.; TOLMINSON, N. P.; PAAS
CORP: Goodyear Aerospace Corp., Los Angeles, CA


MAJORS: AERO DYNAMICS FLIGHT SIMULATION/HEAVING STABILITY/ROTORCRAFT AIRCRAFT
MINS: AERO DYNAMICS LOADS/ AIRCRAFT CONFIGURATIONS/CIVIL AVIATION/ LINEAR SYSTEMS/ MATHEMATICAL MODELS/MILITARY AIRCRAFT/ NONLINEAR SYSTEMS/PERFORMANCE

ABA: (Author)

ABS: Stability characteristics of a buoyant quad-rotor aircraft (BQRA) in hover and forward flight is examined by considering linear, state-variable, and nonlinear flight simulation models of such a configuration. The effects of carrying a slung load on the vehicle dynamics is predicted by considering a coupled model of the two bodies. Inherent stability characteristics of the vehicle are analyzed and compared with those of a helicopter and an airship in free flight. Typical operational conditions that could lead to vehicle instability are described in the flight envelope of interest.

82A10055* ISSUE 1 PAGE 139 CATEGORY 71 RPT: AIAA PAPER 82-2001 CN#: NASP-15730 81/10/00 26 PAGES UNCLASSIFIED DOCUMENT

UTILITY: Helicopter rotor trailing edge noise
AUTH: SCHLICHTER, R. H.; AMERIT, R. K.; PAAS: United Technologies Research Center, East Hartford, CT

CORP: United Technologies Research Center, East Hartford, CT


MAJORS: AEROACoustics/AERO DYNAMICS NOISE/HELICOTER PERFORMANCE/NOISE PREDICTION/AIRCRAFT/ROTARY WINGS/TRAILING EDGES
MINS: NOISE SPECTRUM/REYNOLDS NUMBER/SCALING LAWS/WIND TUNNEL TESTS

ABA: (Author)

ABS: An experimental and theoretical study was conducted to assess the importance of trailing edge noise as a helicopter main rotor broadband noise source. The noise mechanism was isolated by testing a rotor blade segment in an open jet acoustic wind tunnel at close to full scale Reynolds numbers. Boundary layer data and acoustic data were used to develop scaling laws and assess a first principles trailing edge noise theory. Conclusions from the isolated blade study were analytically transformed to the rotating frame coordinate system to develop a generalized rotor noise prediction. Trailing edge noise is then significantly to the total helicopter noise spectrum at high frequencies.
speed, virtually ignoring the low dynamic pressure on
the retreating side, while still keeping the rotor
system in roll trim. Theoretically such a rotor system
will maintain its lift potential as speed increases.
The XH-59A was designed to investigate this theory. A
description is provided of the flight test program
from May 1980 to January 1981. A summary is
presented of the knowledge gained throughout the
entire program, and current pitfalls are reviewed. It
is concluded that the ABC has been verified, with the
XH-59A envelope of blade lift coefficient as a
function of advance ratio greatly exceeding that of
typical conventional helicopter rotor systems.

B1A46610* ISSUE 22 PAGE 3812 CATEGORY 5
81/00/00 16 PAGES UNCLASSIFIED DOCUMENT

AUTH: A/LINDEN, A. W.; B/RUDDELL, A. J. PAA: B/United
Technologies Corp., Sikorsky Aircraft Div., Stratford,
CT

CORP: Sikorsky Aircraft, Stratford, Conn.
(A81-46603 22-01) Washington, DC, American
research.

MAJS: /AERODYNAMIC CHARACTERISTICS/COUPLED HELICOPTERS/
HELICOPTER DESIGN/ MILITARY HELICOPTERS/ RIGID ROTOR
HELDERS/ ROTARY WINGS

MINS: / AIRSPEED/ COUNTER ROTATION/ LIFT/ STRUCTURAL
VIBRATION/ TECHNOLOGY ASSESSMENT

ABA: G.R.

ABS: The Advancing Blade Concept (ABC) uses two rigid
counterrotating rotors in a coaxial arrangement to
provide advancing blades on both sides of the
aircraft. This makes use of the high dynamic pressure
on the advancing side of the rotors at high forward
A method has been developed to predict the high frequency broadband noise due to the interaction of convecting turbulent eddies with the trailing edges of a hovering rotor. The trailing edge noise from each blade was modeled as point dipole noise with spanwise loading corrections. This point dipole approximation was checked by applying the concept to a stationary airfoil in a moving medium with excellent results. In order to estimate the strength of the point dipole, the trailing edge noise theory of Amiet was used. The method was applied specifically to Blade Boundary layer turbulence and compared to incident atmospheric turbulence noise. The results indicate that the relative importance of these two mechanisms is related to the magnitudes of the intensity and of the length scales of the inflow and boundary layer turbulence. The results tend to fall below some available experimental data indicating that in those experiments other broadband noise sources were stronger than boundary layer-trailing edge noise. The approach which was developed is also applicable to other blade-turbulence interaction mechanisms such as local stall and tip noise.
the helicopter obtained from improved, representative, trim procedures. The nonlinear time dependent equilibrium position, or response, about which the equations are linearized is obtained by solving a sequence of linear periodic response problems, using quasi-linearization. Numerous results illustrating blade behavior in forward flight are presented.

B1A36561** ISSUE 16 PAGE 2003 CATEGORY 53
RPT#: AIAA B1-0572 CNT#: NASA-10145 8/1/00/00 11 PAGES UNCLASSIFIED DOCUMENT


CORP: Bell, Bennett, and Newman, Inc. Cambridge, Mass.


MAJS: FLIGHT SIMULATION/HELICOPTER CONTROL/HOWING/MAN MACHINE SYSTEMS/OPTIMAL CONTROL/PILOT PERFORMANCE/ TRAINING ANALYSIS

MINS: CONTROL SIMULATION/CUES/MOTION PERCEPTION/ PERFORMANCE PREDICTION/SYSTEMS SIMULATION/ VISUAL SIGNALS/WORKLOADS (PSYCHOPHYSIOLOGY)

ABA: (Author)

ABS: The optimal control model for pilot/vehicle analysis is used to explore the effects of a CEGI visual system and motion system dynamics on helicopter hover simulation fidelity. This is accomplished by expanding the perceptual aspects of the model to include motion sensing and by relating CGI parameters to information processing parameters of the model. Simulator fidelity is examined by comparing predicted performance and workload for flight with that predicted for various simulator configuration. The results of the analysis suggest that simulator deficiencies can result in substantial performance and/or workload ineficiency. Both CGI and motion system effects are significant for this task. There is also a distinct interaction between the two sources of pilot cues. In particular, the presence of motion reduces the sensitivity to CGI limitations.

B1A34221** ISSUE 15 PAGE 2475 CATEGORY 1 RPT#: AIAA PAPER 81-0123 CNT#: NASA-13479 8/10/00 10 PAGES UNCLASSIFIED DOCUMENT


CORP: United Technologies Corp., Stratford, Conn.

Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, 10 p. Army-Sponsored research:

MALS: AIRCRAFT CONSTRUCTION MATERIALS/ AIRCRAFT PRODUCTION/ AIRFRAME MATERIALS/GRAFITE-EPOXY COMPOSITES/ HELICOPTER DESIGN

MIN: ADHESIVE BONDING/BUCKLING/FABRICATION/FASTENERS/LOAD TESTS/LOW COST/ROOFS/SHEAR STRESS/SKIN (STRUCTURAL MEMBER)/STIFFENING/WEIGHT REDUCTION

ABA: 0.C.

ABS: A design solution is developed for the fabrication of an all-composite helicopter airframe cabin roof structure. Although this is inherently a complex structure, the parts count has been minimized by the avoidance of many mechanical fasteners, and a weight reduction of 26% has been obtained. The reduction of parts and elimination of mechanical fasteners will also result in a lowering of labor costs. The bonded graphite/epoxy elements of the structure employed aluminum tooling with control on all mating surfaces to yield accurate bond lines. A summary of static test results is presented for the basic structure and for the structure with mechanically fastened skin stiffeners. It is shown that the shear buckles caused the skins to peel from the stiffeners at about 960 lb/ft2 shear flow, calling for the addition of stiffeners with more bond area.

B1A30107** ISSUE 20 PAGE 2006 CATEGORY 37
RPT#: ASME PAPER 81-GT-219 CNT#: EF-76-5-2479
DAG29-77-C-0009 NSG-3105 8/1/03/00 9 PAGES UNCLASSIFIED DOCUMENT

AUTH: KUHNER E. J.; B/BARRETT L. E.; C/LI D. F.

PAA: B/(Virginia University, Charlottesville, Va.)/C/LG Research Laboratories, Warren, Mich.)

CORP: Virginia Univ., Charlottesville, General Motors Research Labs., Warren, Mich. SAM: MEMBERS, $2.00 NONMEMBERS, $4.00


MALS: DYNAMIC LOADS/GAS TURBINE ENGINES/HELI-COPTER ENGINES/ROLLER BEARINGS/SHAFTS (MACHINE ELEMENTS)/SQUEEZE FILMS

MIN: ENGINE DESIGN/POWER EFFICIENCY/ROTOR SPEED/SPOOLS

ABA: (Author)

ABS: This paper presents a dynamic analysis of a two-spool gas turbine helicopter engine incorporating shaft rolling element bearings between the gas generator and
power turbine rotors. The analysis includes the nonlinear effects of a squeeze film bearing incorporated into the gas generator rotor. The analysis includes critical speeds and forced response of the system and indicates that substantial dynamic loads may be imposed on the intershaft bearings and main bearing supports with an improperly designed squeeze film bearing. A comparison of theoretical and experimental gas generator rotor response is presented illustrating the nonlinear characteristics of the squeeze film bearing. It was found that large intershaft bearing forces may occur even though the engine is not operating at a resonant condition.

B1A29513* ISSUE 12 PAGE 204 CATEGORY 39
RPT#: AIAA B1-0615 CNT#: NCC2-13 01/00/00 12
PAGES UNCLASSIFIED DOCUMENT

UTTI: Dynamic stability of a rotor blade using finite element analysis

AUTH: A/SIVANERI, N. T.; B/CHOPRA, I. PAA: B/INASA;
Stanford Joint Institute for Aeronautics and
Astronautics; Stanford University, Stanford, Calif.)

CORP: Stanford Univ., Calif.
In: Structures, Structural Dynamics and Materials
Conference, 22nd, Atlanta, Ga., April 6-8, 1981, and
AIAA Dynamics Specialists Conference, Atlanta, Ga.,
April 9-10, 1981, Technical Papers, Part 2,
(A81-29428 12-01) New York, American Institute of

MAJS: /AERODYNAMIC LOADS/AERODYNAMIC STABILITY/FINITE ELEMENT METHOD/HELICOPER DESIGN/ROTOR BLADES

MINS: /AEROELASTIC/ AIRFOIL PROFILES/ DEGREES OF FREEDOM /
/EIGENVALUES/ FLUTTER ANALYSIS/ NONLINEAR EQUATIONS/ PERTURBATION THEORY/ PROPELLER BLADES/ ROTORY WINGS

ABA: (Author)

ABS: The aerelastic stability of flap bending, lead-lag bending, and torsion of a helicopter rotor blade in hover is examined using a finite element formulation based on the principle of virtual work. Quasi-steady (two-dimensional airfoil theory is used to obtain the aerodynamic loads. The rotor blade is discretized into beam elements, each with ten nodal degrees of freedom. The resulting nonlinear equations of motion are solved for steady-state blade deflections through an iterative procedure. The flutter solution is calculated assuming blade motion to be a small perturbation about the steady solution. The normal mode method based on the coupled rotating natural modes about the steady deflections is used to reduce the number of equations in the flutter eigenanalysis. Results are presented for hingeless and articulated rotor blade configurations.

B1A20061* ISSUE 7 PAGE 1087 CATEGORY 37
00/00/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTI: Gear meshing action as a source of vibratory excitation

AUTH: A/MAK; W. D.; B/FOISCHER; R. W. PAA: B/Bolt
Berner and Newman, Inc., Cambridge, Mass.)

In: Symposium on Internal Noise in Helicopters,
Southampton, England, July 17-20, 1979, Proceedings,
(A81-20051 07-71) Southampton, England, University of

MAJS: /AIRCRAFT STABILITY/GEAR TEETH/HELICOPRO Rotor DRIVE/STRUCTURAL VIBRATION/TRANSMISSIONS/MACHINE ELEMENTS

MINS: /AMPLITUDES/ ERROR ANALYSIS/ HARMONIC OSCILLATION/ MEAN SQUARE VALUES/ TRANSFER FUNCTIONS

B0A52645* ISSUE 24 PAGE 4315 CATEGORY 2 CNT#: NSG-2142 00/10/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTI: Effect of tip vortex structure on helicopter noise due to blade-vortex interaction

AUTH: A/WEINLAND, S. E.; B/WOLF, T. L. PAA: B/IMIT,
Cambridge, Mass.)

CORP: Massachusetts Inst. of Tech., Cambridge,

MAJS: /AIRCRAFT NOISE/LIFTING ROTORS/RIGID ROTOR HELICOPTERS/ROTOR AERODYNAMICS/ROTOR BLADES/WING TIP VORTICES

MINS: /ACOUSTIC EMISSION/ HELICOPTER WAVES/ LINEAR EQUATIONS/ SOUND PRESSURE/ UNSTABLE FLOW/ VELOCITY DISTRIBUTION

ABA: (Author)

ABS: A potential cause of helicopter impulsive noise, commonly called blade slap, is the unsteady lift fluctuation on a rotor blade due to interaction with the vortex trailed from another blade. The relationship between vortex structure and the intensity of the acoustic signal is investigated. Unsteady lift on the blades due to blade-vortex interaction is calculated using linear unsteady aerodynamic theory, and expressions are derived for the directivity, frequency spectrum, and transient signal of the radiated noise. The inviscid rollup model of Bér is used to calculate the velocity profile in the trailing vortex from the spanwise distribution of blade tip loading. A few cases of tip loading are investigated, and numerical results are presented for the unsteady lift and acoustic signal due to blade-vortex interaction. The intensity of the acoustic signal is shown to be quite sensitive to changes in tip vortex structures.
frequency broadband noise (LBN) radiated from model helicopter rotors are presented. The results are for a range of tip Mach numbers (M_l) up to 0.50. The effect of rotor blade loading, advance ratio, tip speed, number of blades and free stream turbulence on the sound pressure level (SPL) and the spectrum of LBN have been investigated. The peak SPL of LBN appears to follow the N(M) law: if the effect of rms turbulence velocity is removed. The peak SPL of LBN seems to saturate with increases in advance ratio and with blade loading, and is proportional to the square of the turbulence integral scale when the effect of rms turbulence velocity and M_l are removed. Also, a simple peak SPL scaling law for noise from a helicopter in forward flight due to convected sinusoidal gust is developed. The trend predicted by this scaling law is found to be satisfactory for the variation of the peak SPL of LBN with tip speed.

The paper discusses the design of a higher harmonic blade pitch control system for flight testing on an OH-6A helicopter. Alternative designs for both the mechanical and electronic subsystems are also presented. Among the recommendations set forth are: (1) use electronic analog methods instead of FFT software, delegating spectral analysis and self testing to an Electronic Control Unit. (2) use a digital rather than analog computer for increased flexibility in solution processing; and (3) locate MAC actuators in the nonrotating system and separate these actuators from the primary control system. It is concluded that a target weight for a prototype control...
ABA: (Author)

ABS: A method for selecting a multivariable state feedback controller that simultaneously achieves an a priori specification on closed loop eigenvalues and good mode mixing is presented. The problem is solved by projecting a desired modal matrix onto a constraint set containing the null space of the closed-loop state matrix, while assuring that the projection is in the null space. The feedback matrix follows immediately in the formulation. An example involving a helicopter hover controller is presented.

79A47841* ISSUE 21 PAGE 4036 CATEGORY 71 CNT#: DAAG29-C-037 NSG-2095 75/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTIL: Low-frequency broadband noise generated by a model rotor


CORP: Massachusetts Inst. of Tech., Cambridge


MAJS: /*AERO Dynamic NOISE/*ANECOIC CHAMBERS/*LOW FREQUENCY BANDS/*NOISE SPECTRA/*PROPELLER BLADES/*ROTOR AERODYNAMICS

MINS: /*HELICOPTERS/*NOISE MEASUREMENT/ ROTARY WINGS/ TURBULENT FLOW/ WIND TUNNEL MODELS/ WIND TUNNEL TESTS

ABA: (Author)

ABS: Low-frequency broadband noise generated by model rotors is attributed to the interaction of ingested turbulence with the rotor blades. The influence of free-stream turbulence in the low-frequency broadband noise radiation from model rotors has been extensively investigated. The turbulence was generated in the M.I.T. anechoic wind tunnel facility with the aid of bipolar grids of various sizes. The spectra and the intensity of the low-frequency broadband noise have been studied as a function of parameters which characterize the turbulence and of helicopter performance parameters. The location of the peak intensity was observed to be strongly dependent on the rotor-t IP velocity and on the longitudinal integral scale of turbulence. The size scale of turbulence had negligible effect on the intensity of low-frequency broadband noise. The experimental data show good agreement with an ad hoc model based on unsteady aerodynamics.
WIND TUNNEL MODELS

ABA: (Author)

ABS: It is known that dynamic rotor inflow has a substantial effect on rotor dynamic loads. Despite the complexity of the unsteady flow problem, simple analytical models can be made useful by identifying their parameters from transient response tests without performing flow measurements. Two analytical inflow models are studied: the first is based on an equivalent blade load number, the second is based on time delayed unsteady momentum inflow. In preparation for the experimental data analysis, identifications from simulated test data and an eigenvalue analysis are performed. The experimental results show that the first analytical inflow model is accurate for rotor advance ratios of 0.4 and above, while the second inflow model provides better accuracy. Prediction studies with experimental data not used for the identification are performed to determine the accuracy of the mathematical models.

AEROFOIL OF POOR QUALITY

ABA: P.T.H.

ABS: A comprehensive vibration analysis of rotor blades with spherical pendulum absorbers is presented. Linearized equations of motion for small oscillations about the steady-state deflection of a spherical pendulum on elastic rotor blades undergoing coupled flapwise bending, chordwise bending, and torsional vibrations are obtained. A transmission matrix formulation is given to determine the natural vibrational characteristics of rotor blades with spherical or simple flapping pendulum absorbers. The natural frequencies and mode shapes of a hingeless rotor blade with a spherical pendulum are computed.

TERMINAL 20  PAGE 8 (ITEMS 22-24 OF 130)
Galarkin method of weighted residuals resulting in a finite element formulation of the aeroelastic problem. As an illustration, the method is applied to the coupled flap-lag problem of a helicopter rotor blade in hover. Comparison of the solutions with previously published solutions establishes the convergence properties of the method. It is concluded that this formulation is a practical tool for solving rotary-wing aeroelastic stability or response problems.

79A18657* # ISSUE 6 PAGE 939 CATEGORY 5 CNT#:
NAS1-14522 78/00/00 17 PAGES UNCLASSIFIED
DOCUMENT

UTIL: On methods for application of harmonic control - helicopter vibration reduction by blade pitch variation
AUTH: A/WOOD, E. R.; B/POWERS, R. W.; C/HAMMOND, C. E.
PAA: B/Hughes Helicopters, Culver City, Calif.;
C/I/U.S. Army, Research and Technology Laboratories,
Hampton, Va.)
CORP: Hughes Helicopters, Culver City, Calif.; Army Research and Technology Labs., Fort Eustis, Va.
Proceedings. Volume 1. (A79-18637 06-01) Gallarate,

MAJS: /HARMONIC OSCILLATION*/HELMETOP CONTROL/HELMETOP PROPELLER DRIVE/VARIABLE PITCH PROPELLERS/VIBRATION DAMPING
MINS: / AIRCRAFT MODELS/ VIBRATORY LOADS/ WIND TUNNEL TESTS

ABS: The paper presents data which confirms the effectiveness of higher harmonic blade pitch control in substantially reducing helicopter rotor vibration levels. The data are the result of recent tests on a 2.7-m model conducted in the Langley Research Center's transonic dynamics wind tunnel. Several predictive analyses developed in support of the NASA program are shown capable of accurately predicting both amplitude and phase of the higher harmonic control input required to nullify a single 4-/rev force or moment input. The use of multiple blade feathering inputs in the design of a flightworthy higher harmonic control system is discussed.

79A18658* # ISSUE 6 PAGE 940 CATEGORY 5 CNT#:
NAS2-7613 78/00/00 24 PAGES UNCLASSIFIED
DOCUMENT

UTIL: The role of rotor impedance in the vibration analysis of rotorcraft
AUTH: A/HOHENLBSEH, W. H.; B/YIN, S.-K. PAA:
A/Washington University, St. Louis, Mo.; B/I/Heli
Helicopter Textron, Fort Worth, Tex.
CORP: Washington Univ., St. Louis, Mo.; Textron Bell
Helicopter, Fort Worth, Tex.
Proceedings. Volume 1. (A79-18637 06-01) Gallarate,

MAJS: / AEROELASTICITY/DYNAMIC STRUCTURAL ANALYSIS/ HELOMETER DESIGN/ MECHANICAL IMPEDANCE/ ROTARY WING AIRCRAFT/VIBRATION DAMPING
MINS: / AERODYNAMIC CONFIGURATIONS/ FINITE ELEMENT METHOD/
IMPEDE MATCHING/ MATRIX METHODS/ RIGID ROTORS/ ROTAR BLADES/ STABILITY DERIVATIVES/ TRANSFER FUNCTIONS

ABA: (Author)

ABS: In an improved method which retains the advantage of separate treatment of rotor and airframe, the rotor impedance is used to correct the input to the airframe. This improved method is illustrated for a strongly idealized case of vertical excitation and then for rolling and pitching moment excitation of a forwardly hinged hingeless rotor on an up-focusing flexible mount. Contrary to the usual approach that represents aeroelastic blade motions by a series of normal blade modes in vacuum, the aeroelastic rotor impedances are computed directly with a finite blade element method that includes aerodynamics. The rotor impedance matrix for three or more blades is determined from the root moment impedance for a single blade by a simple multiblade transformation rule. Force and moment amplitudes transferred from the rotor to the support are found to be critically dependent on the support dynamics.

79A18171* ISSUE 5 PAGE 756 CATEGORY 7 RTP#: AHS 78-48 CNT#: NAS2-6500 NAS2-6598 78/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Definition and analytical evaluation of a power management system for tilt-rotor aircraft


MAJS: /AIRCRAFT STABILITY/ COMPUTERIZED DESIGN/ CONVERGENCE/ DESIGN ANALYSIS/ HELICOPTER DESIGN/ TILT ROTOR AIRCRAFT

MINS: /DESIGN ANALYSIS/ DIRECTIONAL CONTROL/ GUST LOADS/ LATERAL CONTROL/ POWER CONDITIONING/ ROTOR SPEED/ SYSTEMS ANALYSIS/ TURBULENCE EFFECTS/ WIND EFFECTS

ABA: (Author)

ABS: The paper reviews the special design criteria which apply to power management in a tilt-rotor aircraft. These include the need for accurate and fast control of rpm and thrust, while accounting for the dynamic interactions between rotor system caused by cross-shafting and aircraft lateral/directional response. The power management system is also required to provide acceptable high speed sensitivity to longitudinal turbulence. It is shown that the criteria can best be met using a single governor adjusting the collective pitch by an amount proportional to a combination of the average rpm and the integral of the average rpm of the two rotors. This system is evaluated and compared with other candidate systems in hover and cruise flight.

79A18156* ISSUE 5 PAGE 758 CATEGORY 8 RTP#: AHS 78-30 CNT#: NAS1-14549 78/00/00 23 PAGES UNCLASSIFIED DOCUMENT

UTTL: Computer-aided system identification techniques for handling qualities and stability and control evaluation


MAJS: /AIRCRAFT STABILITY/ COMPUTERIZED DESIGN/ CONTROLABILITY/ DESIGN ANALYSIS/ HELICOPTER DESIGN/ ROTARY WING AIRCRAFT

MINS: /ALGORITHMS/ DATA PROCESSING/ KALMAN FILTERS/ LEAST SQUARES METHOD/ MAXIMUM LIKELIHOOD ESTIMATES/ ONBOARD EQUIPMENT

ABA: (Author)

ABS: An integrated approach to rotorcraft system identification is described. This approach consists of sequential application of (1) data filtering to estimate states of the system and sensor errors, (2) model structure estimation to isolate significant model effects, and (3) parameter identification to quantify the coefficients of the model. An input design algorithm is described which can be used to design control inputs which maximize parameter estimation accuracy. Details of each aspect of the rotorcraft identification approach are given. Examples of both simulated and actual flight data processing are given to illustrate each phase of processing. The procedure is shown to provide means of calibrating sensor errors in flight data, quantifying high order state variable modeling of the flight data, and consequently computing related stability and control design models.

79A10903* ISSUE 1 PAGE 13 CATEGORY 5 78/00/00 211 PAGES UNCLASSIFIED DOCUMENT


MAJS: /AIRCRAFT STRUCTURES/*CONFERENCES/*HELICOPTER DESIGN
/MANUFACTURING/*SPECIAL MACHINES

MINS: /AIRCRAFT MANEUVERS/ BEARINGLESS ROTORS/ COMPOSITE STRUCTURES/ COMPUTERIZED SIMULATION/ DYNAMIC MODELS/ FUEL-SAFE SYSTEMS/ FINITE ELEMENT METHOD/ LANDING GEAR
/ROTARY WINGS/ ROTOR BLADES/ STRUCTURAL RELIABILITY/ STRUCTURAL WEIGHT/ ULTRASONIC WELDING

ABA: P.T.H.

ABS: Work on advanced concepts for helicopter designs is reported. Emphasis is on use of advanced composites, damage-tolerant design, and load calculations. Topics covered include structural design flight maneuver loads using PDP-10 flight dynamics model, use of 3-D finite element analysis in design of helicopter mechanical components, damage-tolerant design of the YUH-61A main rotor system, survivability of helicopters to rotor blade ballistic damage, development of a multiaxial spar composite main rotor blade, and a bearingless main rotor structural design approach using advanced composites.

78A50202* # ISSUE 22 PAGE 3967 CATEGORY 8 RPT#: AIAA 78-1295 CNT#: NGL-05-020-007 78/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTIL: Approach Guidance logic for a tilit-rotor aircraft
CORP: Intermetrics, Inc., Long Beach, Calif.

MAJS: /AIRCRAFT GUIDANCE/APPRAOCH CONTRO/FLIGHT SIMULATION/TILT ROTOR AIRCRAFT/WIND EFFECTS
MINS: /AIRCRAFT CONFIGURATIONS/ AIRCRAFT DESIGN/ COMMAND AND CONTROL/ CRUISING FLIGHT/ FEEDBACK CONTROL/ FEEDFORWARD CONTROL/ RESEARCH AIRCRAFT/ TILTING ROTORS

ABA: (Author)

ABS: The distinctive feature of a tilit-rotor aircraft is that the pilot can change the rotor mast angles to go from a helicopter configuration for take-off and landing to an airplane configuration for high cruise speeds and vice-versa. An approach path for such an aircraft is proposed and the logic required to fly along this path in the presence of wind is determined. The main contribution of this work is an efficient and, to my knowledge, new method for generating the nominal state and control histories taking into account an estimate of the mean wind velocity and direction. The method requires the solution of algebraic (mostly linear) equations to generate a 'universal nominal', and feedforward and feedback gains. Then, in flight the additional state and control corrections due to deviation in descent rate, deceleration, and flight in a steady wind are obtained by multiplying simple precalculated functions of time by descent rate, deceleration or sine and cosine components of the mean wind vector. Simulations of approach flights for different wind conditions, assuming perfect state information in the feedback signal, indicated satisfactory performance.

78A35371* ISSUE 14 PAGE 2473 CATEGORY 5 CNT#: DAAG29-8-027 NSG-2095 78/04/22 16 PAGES UNCLASSIFIED DOCUMENT

UTIL: A simplified Mach number scaling law for helicopter rotor noise
AUTH: A/ARAVANUDAN, K. S.: B/LEE. A.; C/HARRIS, W. L.
CORP: Massachusetts Inst. of Tech., Cambridge,

MAJS: /AIRCRAFT NOISE/HELIICOPTERS/ROTARY WINGS/SCALING LAWS

MINS: /ANECHOIC CHAMBERS/ BROADBAND/ MACH NUMBER/ ROTOR BLADES (TURBOMACHINERY)/ TIP SPEED/ WIND TUNNEL TESTS

ABA: P.T.H.

ABS: Mach number scaling laws are derived for the rotational and the high-frequency broadband noise from helicopter rotors. The rotational scaling law is obtained directly from the theory of Cowan and Ollerhead (1969) by exploiting the properties of the dominant terms in the expression for the complex Fourier coefficients of sound radiation from a point source. The scaling law for the high-frequency broadband noise is obtained by assuming that the noise sources are acoustically compact and computing the instantaneous pressure due to an element on an airfoil where vortices are shed. Experimental results on the correlation lengths for stationary airfoils are extended to rotating airfoils. On the assumption that the correlation length varies as the boundary layer displacement thickness, it is found that the Mach number scaling law contains a factor of Mach number raised to the exponent 5/3. Both scaling laws were verified by model tests.

78A14063* ISSUE 3 PAGE 467 CATEGORY 60 CNT#: NAS2-7806 I/SF ENG-76-07811 77/11/00 11 PAGES UNCLASSIFIED DOCUMENT

UTIL: Peripheral processors for high-speed simulation --- helicopter Cockpit simulator
AUTH: A/KARPLUS, W. J. PAA: A/California, University, Los Angeles

ORIGINAL PAGE 18
An experimental investigation of helicopter rotor high
frequency broadband noise.

Robert W. Gaffney and John A. Cathey

7th AIAA Aeroacoustics Conference

An experimental investigation of helicopter rotor high
frequency broadband noise.

Robert W. Gaffney and John A. Cathey

7th AIAA Aeroacoustics Conference

MAJS: /CH-47 HELICOPTER/ *DIGITAL SYSTEMS*/ FLIGHT CONTROL/ HELICOPTER CONTROL/ SYSTEMS ENGINEERING/ TANDEM ROTOR HELICOPTERS

MINS: / CONTROLABILITY/ EIGENVALUES/ EIGENVECTORS/ FLIGHT CHARACTERISTICS/ OPTIMAL CONTROL/ STATE VECTORS

ABA: (Author)

ABS: Methods and results in the continuing development of a digital flight control system (DFCS) for the CH-47B helicopter are examined. The helicopter is the research vehicle for the NASA VTOL Approach and Landing Technology (VALT) Program. It is equipped with comprehensive equipment for the investigation of navigation, guidance, and control requirements for future VTOL aircraft. Two control modes (attitude-command and velocity-command) are implemented, and each mode provides 'Type 1' response to guidance commands. DFCS design is based upon optimal estimation and control methods, which are found to provide flexible and efficient means for defining practical digital control systems.

UTLI: Performance and safety aspects of the XV-15 tilt rotor research aircraft


CORP: Bell Helicopter Co., Fort Worth, Tex.


MAJS: / AIRCRAFT PERFORMANCE/ AIRCRAFT SAFETY/ XV-15 AIRCRAFT

MINS: / AIRCRAFT CONTROL/ AIRCRAFT STABILITY/ GROUND TESTS/ POWER CONDITIONING/ TILT ROTOR RESEARCH AIRCRAFT PROGRAM

ABA: (Author)

ABS: Aircraft performance is presented illustrating the flexibility and capability of the XV-15 to conduct its planned flight/ground research in the areas of dynamics, stability and control, and aerodynamics. Additional research is conducted with emphasis on the safety and fail-operate features of the aircraft and its systems. Two or more levels of redundancy are provided in the DC and AC electrical systems, hydraulics, conversion, flaps, landing gear extension, SCAS, and force feed. RPM is maintained by a hydro-electrical blade pitch governor that consists of a primary and standby governor with a cockpit wheel control for manual backup. The two engines are interconnected for operation on a single engine. In the event of total loss of power, the aircraft can enter autorotation starting from the airplane as well as the helicopter mode of flight.

ORIGINAL PAGE 15

OF POOR QUALITY
operations. Two distinct discrete-time control laws are
designed to interface with velocity-command and
attitude-command guidance logic, and each incorporates
proportional-integral-derivative (PID) control for
data transfer and set-point regulation, as well as
reduced-order Kalman filters for sensor blending and
noise reduction. Adaptation to flight condition is
achieved with a novel gain-scheduling method based on
correlation and regression analysis. The
linear-optimal design approach is found to be a
valuable tool in the development of practical
multivariable control laws for vehicles which evidence
significant coupling and insufficient natural

A technique is presented for calculating feedback and
feedforward gain matrices that enable a VTOL aircraft to
track input commands of forward and vertical
velocity while maintaining acceptable responses to
pilot inputs. Leverrier's algorithm is used for
determining a set of state-variable feedback gains
that force the closed-loop poles and zeros of one
pilot-input transfer function to pre-selected
positions in the s-plane. This set of feedback gains is
then used to calculate the feedback and feedforward
gains for the velocity-command controller. The method
is computationally attractive since the gains are
determined by solving systems of linear, simultaneous
equations. The method has been used in a digital
simulation of the CH-47 helicopter to control
longitudinal dynamics.
composite bearingless rotors. Various assumptions upon which conventional rotor aerelastic analyses are formulated are violated. Three such features identified are highly nonlinear and time-varying structural twist, structure, redundancy in bending and torsion, and for certain configurations a strongly coupled low frequency bending-torsion mode. An examination of these aerelastic considerations and appropriate formulations required for accurate analyses of such rotor systems is presented. Also presented are test results from a dynamically scaled model rotor and complimentary analytic results obtained with the appropriately reformulated aerelastic analysis.

77A26867* ISSUE 11 PAGE 1761 CATEGORY 5 CNT#: NGR-05-007-414 76/00/00 20 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aerelastic stability of composite rotors with application to a teetering rotor in forward flight


CORP: California Univ., Los Angeles. 


MAJUS: /AERODYNAMIC LOADS/AERODYNAMICITY/AIRCRAFT STABILITY/*FLIGHT TESTS/*HELICOPTERS/*ROTARY WINGS

MINS: /AERODYNAMIC STABILITY/ EQUATIONS OF MOTION/ NONLINEAR EQUATIONS

ABA: (Author)

ABS: The derivation of a set of nonlinear coupled flap-lag-torsion equations of motion for moderately large deflections of an elastic, two bladed teetering helicopter rotor in forward flight is concisely outlined. The following degrees of freedom are included in the mathematical model: rigid body flapping, rigid body lead lag, elastic bending in flap and lag-lag blade root torsion and shaft torsion. Quasi-steady aerodynamic loads are considered and the effects of reversed flow are included. The aerelastic stability of the complete rotor is investigated using a linearized system of equations of motion. The equilibrium position about which the equations are linearized is obtained by considering the trim state of the helicopter. In true or simulated forward flight conditions. The sensitivity of the aerelastic stability boundaries to interblade structural and mechanical coupling is illustrated by comparing the complete rotor stability boundaries with those obtained from a single blade analysis for a number of
hover and forward flight cases.

77A268660+ ISSUE 11 PAGE 1760 CATEGORY 5 76/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Higher harmonic rotor blade pitch control
AUTH: A/Fairchild Republic Co., Farmingdale, N.Y.
CORP: Fairchild Republic Co., Farmingdale, N.Y.

MAJUS: \{HELIPICTOR CONTROL/PITCH INCLINATION\}/VARIABLE PITCH PROPELLERS

MINS: \{HARMONIC MOTION/MECHANICAL DRIVES/REVERSING/variable pitch propellers\}

ABA: (Author)

ABS: Tests of a model 'Reverse Velocity Rotor' system at high advance ratios and with twice-per-revolution cyclic pitch control were made under joint Navy-NASA sponsorship in the NASA Ames 12 ft. pressure tunnel. The results showed significant gains in rotor performance at all advance ratios by using twice-per-revolution control. Detailed design studies have been made of alternative methods of providing higher harmonic motion including four types of mechanical systems and an electro-hydraulic system. The relative advantages and disadvantages are evaluated on the basis of stiffness, weight, volume, reliability and maintainability.

77A25812+ ISSUE 10 PAGE 1562 CATEGORY 5 77/00/00 13 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aerodynamic stability of coupled flap-lag-torsional motion of helicopter rotor blades in forward flight
AUTH: A/Friedmann, P.B./Reyna-Allen, M.P.
CORP: California Univ., Los Angeles

MAJUS: \{AERODYNAMIC STABILITY/AEROELASTICITY/HELIPICTOR CONTROL/MOTION STABILITY/ROTOR WINGS/TORSIONAL VIBRATION\}

MINS: \{EQUATIONS OF MOTION/FLAPS (CONTROL SURFACES)/FLIGHT CONDITIONS/FLIGHT SIMULATION/HOVERING/\}

ABA: F.G.M.

ABS: A set of coupled periodic nonlinear differential flap-lag-torsional equations of blade motion is described which can simulate a blade having a preconceived twist, distributed torsion, root torsion, offset, blade-root offsets, and offsets among the elastic axes, the aerodynamic center, and the blade cross-sectional center of mass. It is noted that the aerodynamic loads derived for these equations are applicable to cases of both hover and forward flight. The aerelastic stability of a hingeless helicopter blade is investigated by linearizing the nonlinear differential equations of motion about a time-dependent equilibrium position of the helicopter in forward flight. Using propulsion and moment trim procedures, a comparison of the results with those obtained previously for coupled flap-lag-torsional boundaries in hover indicates that aerelastic stability margins are degraded due to forward flight.

76A47210+ ISSUE 24 PAGE 3853 CATEGORY 63 CNT#: NGR-05-007-414 76/00/00 3 PAGES UNCLASSIFIED DOCUMENT

UTTL: A technique for pole-zero placement for dual-input control systems --- computer simulation of CH-47 helicopter longitudinal dynamics
AUTH: A/Reid, G.F.
PAA: A/Virginia Military Institute.

MAJUS: \{CH-47 HELICOPTER/COMPUTERIZED SIMULATION/CONTROL SIMULATION/HELICOPTER CONTROL/LONGITUDINAL CONTROL\}

MINS: \{ALGORITHMS/FEEDBACK CONTROL/LINEAR EQUATIONS/TRANSFER FUNCTIONS\}

ABA: (Author)

ABS: A technique is presented for determining state variable feedback gains that will place both the poles and zeros of a selected transfer function of a dual-input control system at pre-determined locations in the s-plane. Leverrier's algorithm is used to determine the numerator and denominator coefficients of the closed-loop transfer function as functions of the feedback gains. The values of gain that match these coefficients to those of a pre-selected model are found by solving two systems of linear simultaneous equations. The algorithm has been used in a computer simulation of the CH-47 helicopter
control longitudinal dynamics.

76A388080* ISSUE 18 PAGE 2874 CATEGORY 71
RPT#: AIAA PAPER 76-564 CNT#: NAS2-7684 76/07/00
8 PAGES UNCLASSIFIED DOCUMENT

UUTL: An experimental study of helicopter rotor rotational
noise in a wind tunnel
AUTH: A/LEE, A.; B/HARRIS, W. L.; C/WINDNALL, S. E. PAA:
C/MIT, Cambridge, Mass.)
CORP: Massachusetts Inst. of Tech., Cambridge.:
American Institute of Aeronautics and Astronautics:
Aero-Acoustics Conference, 3rd. Palm, Calif.,
MAJS: *AIRCRAFT NOISE/*HELICOPTERS/*ROTARY WINGS/*WIND
TUNNEL TESTS
MINS: / ACOUSTIC MEASUREMENT/ ANECHOIC CHAMBERS/ DATA
PROCESSING/ DIRECTIVITY
ABA: (Author)

ABS: The rotational noise of model helicopter rotors in
forward flight was studied in an anechoic wind tunnel. The
parameters under study were the rotor thrust (blade loading), blade number and advance ratio. The
separate effects of each parameter were identified
with the other parameters being held constant. The
directivity of the noise was also measured. Twelve
sets of data for rotational noise as a function of
frequency were compared with the theory of Lowson and
Butler. In general, the agreement is reasonably
good, except for the cases of low and high
loadings. (2) the four bladed rotor, and (3) low
advance ratios. The theory always under-estimates the
rotational noise at high harmonics.

76A338650* ISSUE 17 PAGE 2590 CATEGORY 6
76/07/00 7 PAGES UNCLASSIFIED DOCUMENT

UUTL: A model-based analysis of a display for landing
approach
AUTH: A/HESS, R. A.; B/HEAT, L. W. PAA: B/(U.S. Naval
Postgraduate School, Monterey, Calif.)
CORP: Naval Postgraduate School, Monterey, Calif.:
IEEE Transactions on Systems. Man. and Cybernetics,
research.
MAJS: *AIRCRAFT LANDING/*APPROACH CONTROL/*CONTROL
SIMULATION/*DISPLAY DEVICES/*HELICOPTER CONTROL/*MAN
MACHINE SYSTEMS/*PILOT PERFORMANCE
MINS: / COCKPITS/ COMPUTERIZED SIMULATION/ HELICOPTER
PERFORMANCE/ MANUAL CONTROL/ MATHEMATICAL MODELS
ABA: (Author)

ABS: A control theoretic model of the human pilot was used to
analyze a baseline electronic cockpit display in a
helicopter landing approach task and to generate
display quickening laws designed to improve
pilot/vehicle performance. A simple fixed base
simulation provided comparative tracking data which
allowed refinement of the pilot model.

76A32845* ISSUE 15 PAGE 2239 CATEGORY 5 CNT#:
NCR-05-007-414 75/09/00 30 PAGES UNCLASSIFIED

UUTL: Aerodynamic stability of trimmed helicopter blades in
forward flight
AUTH: A/FRIDMANN, P.; B/SAMIE, J. PAA: B/(California
University, Los Angeles, Calif.)
CORP: California Univ., Los Angeles:
European Hovercraft and Powered Lift Aircraft Forum:
1st. University of Southampton, Southampton, England,
research.
MAJS: *AERODYNAMIC STABILITY/*AEROELASTICITY/*HELICOPTERS/*
RIGID ROTORS/*ROTARY WINGS
MINS: / AERODYNAMIC LOADS/ EQUATIONS OF MOTION/ FLIGHT
CHARACTERISTICS/ FLOQUET THEOREM/ LINEAR EQUATIONS
ABA: (Author)

ABS: Equations for moderately large amplitude coupled
flap-lag motion of a torsionally rigid hingeless
helicopter blade in forward flight are
derived. Quasi-steady aerodynamic loads are considered
and the effects of reversed flow are included. By
using Galerkin's method the spatial dependence of the
problem is eliminated and the equations are linearized
about a time dependent equilibrium position determined
from the trimmed equilibrium position of the rotor in
forward flight. In the first trim procedure the rotor
is maintained at a fixed value of thrust coefficient
with forward flight and horizontal and vertical force
equilibrium is satisfied in addition to maintaining
zero pitch and roll moments. The second trim procedure
maintains only zero pitch and roll moment simulating
conditions under which a rotor would be tested in the
wind tunnel.

76A308661* ISSUE 14 PAGE 2097 CATEGORY 8 CNT#:
NAS2-5143 76/03/00 6 PAGES UNCLASSIFIED DOCUMENT

UUTL: Near-hover control of a helicopter with a hanging load
AUTH: A/GUPTA, N. K.; B/ERYSON, A. E., JR. PAA:
A/(Systems Control, Inc., Palo Alto, Calif.);
B/(Stanford University, Stanford, Calif.)
CORP: Stanford Univ., Calif.; Systems Control, Inc., Palo
Alto, Calif.
MAJS: / AUTOMATIC PILOTS/*GUST LOADS/*HELICOPTER CONTROL/
HOVERING/*PERFORMANCE PREDICTION
MINS: / CABLES (ROPES)/ FEEDBACK CONTROL/ HELICOPTER DESIGN/
POSITION ERRORS/ WIND EFFECTS

ABA: (Author)

ABS: Piloting a helicopter with a hanging load is a difficult task, especially when the mass of the load is a significant fraction of the mass of the vehicle and there are gusty winds. An autopilot logic is proposed here for controlling the helicopter in this configuration and for precision hover. It is proposed that the vehicle position be measured using a lightweight cable from the helicopter to a point on the ground near the desired hover point. Simulation with one version of S-61 Sikorsky helicopter shows satisfactory controller performance under both design conditions and for parameter changes from one mission to another. Assuming noise-free measurements for feedback is found to be far too optimistic in predicting performance, the sensor/estimator design is a key element in the controller.

76A30047# ISSUE 13 PAGE 1970 CATEGORY 39
CNO#: NGR-05 007-414 76/00/00 14 PAGES
UNCLASSIFIED DOCUMENT

Uttl: Effect of modified aerodynamic strip theories on rotor blade aerelastic stability
AUTH: A. FRIEDMANN, P.; B. YUAN, C. PAA: B/(California, University, Los Angeles, Calif.)
CORP: California Univ., Los Angeles,
P. 398-411

Majs: /AEROELASTICITY/AIRCRAFT STABILITY/FIXED WINGS/ROTARY WINGS/ROTOR BLADES

MIN: /ANGLE OF ATTACK/DYNAMIC STRUCTURAL ANALYSIS/FREE FLOW/HELICOPTER DESIGN/-hovering/ROTOR AERODYNAMICS/STRIP/WING FLAPS

ABA: (Author)

ABS: Various existing unsteady aerodynamic strip theories which have been developed in the past for both fixed and rotary wing aeroelastic analyses are modified in the paper so as to make them applicable to the coupled flap-lag-torsional aeroelastic problem of a rotor blade in hover. These corrections are primarily due to constant angle of attack, constant inflow and variable free stream velocity due to lead-lag motion. Next, the modified strip theories are incorporated in a coupled flap-lag-torsional aeroelastic analysis of the rotor blade in hover and the sensitivity of the aeroelastic stability boundaries to the aerodynamic assumptions is examined.

76A20929# ISSUE 8 PAGE 1071 CATEGORY 2 RPT:
AIAA PAPER 76-81 CNT#: NAS1-13372 76/01/00 17 PAGES UNCLASSIFIED DOCUMENT

Uttl: Evaluation of vortex noise from nonrotating cylinders and airfoils
AUTH: A. SCHLIXER, R. H.; B. AMIRI, R. K.; C. FINN, M. R.
PAA: B/(United Technologies Research Center, East Hartford, Conn.)
CORP: United Technologies Research Center, East Hartford, Conn.

American Institute of Aeronautics and Astronautics.
17 p.

Majs: /AEROELASTIC NOISE/AIRCRAFT NOISE/HELICOPTER TAIL ROTORS/SOUND GENERATORS/ VORTEX STREETS/WIND TUNNEL TESTS

MIN: /ACOUSTIC MEASUREMENT/AIRFOILS/CIRCULAR CYLINDERS/FULL SCALE TESTS/NOISE SPECTRA/REYNOLDS NUMBER/SOUND FIELD/SURFACE ROUGHNESS EFFECTS

ABA: (Author)

ABS: An experimental study of vortex-shedding noise was conducted in an acoustic research tunnel over a Reynolds number range applicable to full-scale helicopter tail-rotor blades. Two-dimensional tapered-chord nonrotating models were tested to simulate the effect of spanwise frequency variation on the vortex-shedding mechanism. Both a tapered circular cylinder and tapered airfoil models were measured for each configuration. Vortex-shedding noise for tapered cylinders and airfoils was found to contain many narrow band-random peaks which occurred within a range of frequencies corresponding to a predictable Strouhal number referenced to the maximum and minimum chord. The noise was observed to depend on surface roughness and Reynolds number.
The paper presents some results of a program undertaken to define navigation and guidance requirements for commercial VOTOL operations in the takeoff, climb, terminal, and landing phases of flight in weather conditions up to and including Category III. Quantitative navigation requirements are given for the parameters range, coverage, operation near obstacles, horizontal accuracy, multiple landing aircraft, multiple pad requirements, inertial/radio-inertial requirements, reliability/redundancy, update rate, and data link requirements in all flight phases. A multi-configuration straw-man navigation and guidance system for commercial VOTOL operations is presented. Operation of the system is keyed to a fully automatic approach for navigation, guidance and control, with pilot as monitor-manager. The system is a hybrid navigator using a relatively low-cost inertial sensor with DME updates and MLS in the approach/departure phases.

A comprehensive plan for helicopter drag reduction

AUTH: A/Williams, R. M.; B/Montana, P. S. PAA: B/(U.S. Naval National Command, Ship Research and Development Center, Bethesda, Md.)


A simple system for measuring the forces acting on a helicopter which will aid in reducing the overall drag is described. The system is designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel. The system is also designed to measure the forces and moments acting on the helicopter in a wind tunnel.

MAJS: /AERODYNAMIC DRAG/ BLUFF BODIES/ DRAG REDUCTION/ HELICOPTER DESIGN/ SEPARATED FLOW

ABSTRACT: Current helicopters have parasitic drag levels 6 to 10 times as great as fixed wing aircraft. This means that the design of the fuselage is critical to the overall performance of the aircraft. The paper traces the origins of the fuselage design process and shows that the problem is primarily due to the design of the fuselage. The paper also describes the use of computer programs to design the fuselage. The paper concludes that the fuselage design process is critical to the overall performance of the aircraft.

MAJS: /AERODYNAMIC DRAG/ LIFT/ OPTIMIZATION/ PRESSURE DISTRIBUTION/ TEST FACILITIES/ THIN WINGS/ TRANSonic FLOW/ WIND TUNNEL STABILITY TESTS

ABSTRACT: A review of current techniques for attaining technical objectives in three areas of semiautomatic airfoil development: software, hardware, and applications. Software objectives seek improved mathematical models and computer codes for flow analysis and design optimization for a variety of conditions. The 17-step iterative computer model used in designing the GA (W)-1 airfoil is effective but not yet fully automated; with present methods only single-point computer optimization is possible. Hardware objectives calling for improvement in test facilities and techniques are met in part by the introduction of the Langley (F-3C) wind tunnel for independent evaluation of transonic Mach number and Reynolds effects up to 12-16 million, and by the two-dimensional test section for the Langley 1/3 transonic cryogenic tunnel which will extend the Reynolds number to 50 million. The current status of low-speed, thin, and rotorcraft airfoil developments is discussed.
75A38349*# ISSUE 1A. PAGE 2623 CATEGORY 2
75/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTIL: "Analytical and experimental evaluation of airflow sections for helicopter rotor application"


MAJS: /*AERODYNAMIC COEFFICIENTS/AIRFOIL PROFILES*/

MIN'S: /*LIFT DRAG RATIO/MACH NUMBER/PREDICTION ANALYSIS TECHNIQUES/WING LOADING

ABA: S.D.

ABS: The influence of the more independent airfoil parameters such as thickness, thickness distribution, leading-edge radius, camber, and camber distribution on lift-Mach number characteristics is investigated at lift coefficients up to near-maximum lift. The analysis is based on the drag divergence Mach number (Md) prediction techniques, where Md is the free-stream Mach number, at which the rate of increase of drag coefficient with Mach number equals 0.1. The analytical results obtained indicated the compromise in Md which result from changes in thickness ratio, location of maximum thickness, leading edge radius, camber addition, and location of maximum camber for four- and five-digit airfoils and some six-series airfoils of potential interest for helicopters. An example of airfoil sections which combines several of the favorable geometric changes is evaluated analytically and experimentally. A comparison of results shows that the relative effect of the geometric changes on the lift coefficient-Md relation is realistic, and that the methods of analysis employed can be effectively used during preliminary vehicle design and airfoil selection.

75A37505*# ISSUE 1B. PAGE 2622 CATEGORY 5
75/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTIL: Rotorcraft low-speed download drag definition and its reduction


MAJS: /*DRAG REDUCTION/HelicopEr DESIGN/LOW SPEED STABILITY/ROTOR SPEED/ROTORCRAFT AIRCRAFT

MIN'S: /*AIRCRAFT FUELS/HELICOPTER PERFORMANCE/PAYLOADS/POTENTIAL FLOW/ROTOR AERODYNAMICS

ABA: (Author)

ABS: Download drag for rotorcraft in hover and low-speed flight is a burden which significantly affects useful load, fuel, and payload. Reduction of this burden will enhance these aspects of rotorcraft design and complement the forthcoming improvements in isolated rotor performance. Analyses and experimental data are available, though fragmentary, regarding gross drag, thrust recovery, and other characteristics which can be utilized to define interim rotorcraft design.
changes to reduce the burden. Eventually the
experimental data and a comprehensive combination of
rotor, rotor-wake, and potential-flow analyses can
evolve to reduce the burden to an absolute minimum.

75A33485# ISSUE 15 PAGE 2119 CATEGORY 2
75/04/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Theoretical study of lift-generated vortex wakes
pragmatically to avoid rollup
AUTH: A/ROSSOW. V. J. PAA: A/(NASA. Ames Research Center,
Moffett Field, Calif.)
MAJS: /*AERODYNAMIC FORCES/*AIRCRAFT MAKES/*LIFTING BODIES/
ROLLING MOMENTS/*VORTEX SHEETS
MINS: *FLOW CHARACTERISTICS/ HELICOPTER MAKES/ LIFTING
ROTORS/ NUMERICAL ANALYSIS/ RADIAL DISTRIBUTION/
TURBULENT FLOW/ VELOCITY DISTRIBUTION/ VORTEX
GENERATORS

ABA: (Author)
ABS: Two hypothetical vortex wakes are introduced and
studied theoretically to explore whether the rollup of
lift-generated vortex sheets can be suppressed. The
circulation distribution across each wake is specified
such that one rotates and the other translates as a
unit due to their self-induced velocities. Several
span loadings are constructed from these solutions
and the resulting inviscid wake structure is computed for
several span lengths behind the generating wing by use of
the discrete vortex method wherein the vortex wake
is represented by an array of vortices. The final
distribution of vortices is then used to estimate the
rolling moment on an encountering wing. It is found
that, even though the initial specified motions are not
sustained, substantial reductions in rolling
moment are predicted for certain ranges of the ratio
of the span of the generating wing to the following
wing.

75A25235# ISSUE 10 PAGE 1397 CATEGORY 2 RPT:
AIAA PAPER 75-453 CNT#: NGR-09-G10-005 75/03/00 7
PAGES UNCLASSIFIED DOCUMENT

UTTL: Thickness noise of helicopter rotors at high tip
speeds
AUTH: A/FARASSAT. F.; B/PEGG. R. J.; C/HILTON. D. A.
PAA: A/(NASA. Langley Research Center; George
Washington University. Hampton. Va.); C/(NASA.
Langley Research Center. Hampton. Va.)
American Institute of Aeronautics and Astronautics.
MAJS: /*AERODYNAMIC NOISE/*NOISE MEASUREMENT/*ROTARY WINGS/
ROTAR SPEED/*TIP SPEED

MINS: / AIRFOIL PROFILES/ COMPUTER PROGRAMS/ FAR FIELDS/
HELICOPTER PERFORMANCE/ HIGH SPEED/ NOISE REDUCTION
ABA: (Author)
ABS: A new formulation of helicopter rotor thickness noise
for hover and forward flight is discussed. The
parameters required for this formulation are rotor
motion, planform and airfoil thickness distribution. A
computer program has been developed to calculate the
pressure signature due to blade thickness for a
helicopter in arbitrary motion. Comparison with
high-speed helicopter tests shows good agreement with
calculations when the observer is on or near the
horizontal plane in which the rotor disk lies.
Characteristics of thickness noise are illustrated by
numerical examples indicating strongly that the
high-speed blade slap may be due primarily to the
thickness effect. The methods of Deming and Arnold
are discussed as the special cases of this technique.

75A22497# ISSUE 8 PAGE 1067 CATEGORY 5 RPT:
AIAA PAPER 75-275 CNT#: NASA-8048 75/02/00 10
PAGES UNCLASSIFIED DOCUMENT

UTTL: Rotary-wing aircraft systems for the short-haul market
AUTH: A/MAGEE. J. P.; B/CLARK. R. D.; C/GIULIANETTI. D.
PAA: B/(Boeing Vertol Co.. Philadelphia. Pa.);
C/(NASA. Washington. D.C.)
American Institute of Aeronautics and Astronautics.
Annual Meeting and Technical Display. 11th.
MAJS: /*HELICOPTER DESIGN/*PASSenger AIRCRAFT/*ROTARY WING
AIRCRAFT/*SHORT HAUL AIRCRAFT
MINS: / COST ANALYSIS/ DESIGN ANALYSIS/ FUEL CONSUMPTION/
NOISE REDUCTION/ TANDEM ROTOR HELICOPTERS/
TECHNOLOGICAL FORECASTING/ TILTING ROTORS/ V/STOL
AIRCRAFT

ABA: (Author)
ABS: This paper describes preliminary designs of tilt-rotor
and tilt-rotor helicopter V/STOL aircraft for the
1980 short-haul market. These designs include a
tilt-rotor aircraft designed for STOL-only operation.
The baseline designs are presented with technological
and cost data. The impact of noise and ride qualities
on aircraft size and cost, and on passenger acceptance
are discussed. The results of the study are compared
against competitive alternatives in air
transportation.
of a large transport helicopter showed that the guidelines do not impose severe economic penalties on helicopter operations.

75A15952* ISSUE 4 PAGE 476 CATEGORY 2 7/4/12/00 7 PAGES UNCLASSIFIED DOCUMENT
UTTL: Lifting-surface theory for a semi-infinite wing in arbitrary gust
Navy-supported research.
MAJS: /GUST LOADS/ LIFTING BODIES/ SURFACE GEOMETRY/ THIN WINGS/ WIND EFFECTS/ WING PROFILES
MINS: /COMPRESSIBLE FLOW/ HELICOPTER DESIGN/ NUMERICAL ANALYSIS/ ROTARY WINGS/ ROTOR BLADES/ TURBULENCE EFFECTS/ TWO DIMENSIONAL BODIES
ABA: (Author)
ABS: An unsteady lifting-surface theory is developed for
the calculation of the airload on a semi-infinite-span thin wing in a compressible flow due to interaction with an oblique gust. By using the solutions obtained for a two-dimensional wing, the problem is formulated so that the unknown is taken to be the difference between the airload on the semi-infinite wing and that on a two-dimensional wing under the same gust conditions. Since this airload difference is nonzero only near the wing tip, the control points at distributed in the tip region only; this significantly simplifies the numerical procedure. Results are presented for a wing with rectangular tip. The implication for noise and unsteady loads due to blade-vortex interaction for helicopter rotors is discussed.

75A12197# ISSUE 2 PAGE 220 CATEGORY 37 RPT#: ASLE PREPRINT 74C-1C-2 DNT#: NAS3-16720 74/10/00 12 PAGES UNCLASSIFIED DOCUMENT

TITLE: Mainshaft seals for small gas turbine engines
MAJS: /GAS TURBINE ENGINES/HOIELTER ENGINES/ROTTING SHAFTS/SEALS (STO/PER)
MINS: /AIR FLOW/GAS-SOLID INTERFACES/HIGH TEMPERATURE AIR/LIFT AUGMENTATION
ABA: (Author)

ABS: An experimental evaluation of mainshaft seals for small gas turbine engines was conducted with shaft speeds to 213 m/sec, air pressures to 215 psia, and air temperatures to 412 K. A radial face seal incorporating self-acting geometry for lift augmentation was evaluated. In addition, three conventional carbon seal types (face, circumferential segmented, and rotating ring) were run for comparison. Test results indicated that the conventional seals used in this evaluation may not be satisfactory in future advanced engines because of excessive air leakage. On the other hand, the self-acting face seal shown to have the potential capability of limiting leakages to one-half that of the conventional face seals and one-fifth that of conventional ring seals. A 150 hour endurance test of the self-acting face seal was conducted at speeds to 145 m/sec, air pressures to 180 psia, and air temperatures to 408 K. The seal wear was not measurable.

75A11823# ISSUE 2 PAGE 248 CATEGORY 47 74/10/00 20 PAGES UNCLASSIFIED DOCUMENT

TITLE: A boundary-layer analysis of atmospheric motion over a semi-elliptical surface obstruction
MAJS: /ATMOSPHERIC BOUNDARY LAYER/BOUNDARY LAYER EQUATIONS/EILLPTICAL CYLINDERS/FLOW DISTORTION/SURFACE ROUGHNESS EFFECTS/TURBULENT BOUNDARY LAYER
MINS: /ASPECT RATIO/ATMOSPHERIC TURBULENCE/FLOW VELOCITY/PRESSURE GRADIENTS/REYNOLDS NUMBER/VISCOSITY/WIND VELOCITY
ABA: A.T.S.

ABS: Flow over surface obstructions can produce adverse flying conditions for helicopters, V/STOL vehicles, etc. The disturbed boundary-layer concept is applied in approximating the localized flow field induced around a surface obstruction (modeled by a two-dimensional cylinder with elliptical cross section) by an impinging wind. The analysis concludes that (1) localized wind-speed maxima occur at the top of a surface obstruction, which are expected in physically real flows; (2) increased elliptical aspect ratio decreases with speed within the boundary layer at the top of the ellipse; (3) increased surface roughness decreases velocity in the boundary layer; (4) Reynolds number has a negligible effect on the overall flow for the Re range considered; (5) decreased elliptical aspect ratio and increased surface roughness cause larger separation regions.

75111114# ISSUE 1 PAGE 9 CATEGORY 5 RPT#: AIAA PAPER 74-1277 74/10/00 11 PAGES UNCLASSIFIED DOCUMENT

TITLE: The rotor systems research aircraft - A flying wind tunnel
MAJS: /DESIGN SYSTEMS/FLIGHT TEST VEHICLES/HOIELTER PERFORMANCE/RESEARCH AIRCRAFT/ROTOR AERODYNAMICS/FIXED WINGS/ROTOR AERODYNAMICS/S-51 HELICOPTER/WIND TUNNELS
ABA: (Author)

ABS: The Sikorsky Aircraft division of United Aircraft
Corporation is constructing two uniquely designed Rotor Systems Research Aircraft (RSRA). These aircraft will be used through the 1980's to comparatively test new rotor concepts for different types of rotors - articulated, hingeless, teetering, and gimbaled, as well as advanced rotor concepts, such as reverse velocity and variable diameter rotors. The RSRA combines a new airframe with existing Sikorsky H-3 (S-61) dynamic components. A force measurement system is incorporated to permit accurate evaluation of significant rotor characteristics. Both rotor and fixed-wing control systems are provided, appropriately integrated for operation in the pure helicopter mode, compound helicopter mode, and fixed-wing mode. The RSRA is the first rotary wing aircraft designed with a crew escape system, including a pyrotechnic system to sever the main rotor blades.

474A37507*# ISSUE 18 PAGE 2639 CATEGORY 32
47/00/06 17 PAGES UNCLASSIFIED DOCUMENT

UTTL: Hingeless rotor theory and experiment on vibration reduction by periodic variation of conventional controls.

AUTH: A/SISSINGH, G. J.; B/DONHAM, R. E. PAA: B/(Lockheed-California Co., Burbank, Calif.)

MAJS: /PERIODIC VARIATIONS/ RIGID ROTORS/ Rotor Aerodynamics/ Rotor Blades/ Structural Vibration/ Vibration Damping

MINS: / FLAPPING/ FREQUENCY RESPONSE/ HELICOPTER DESIGN/ MATHEMATICAL MODELS/ PITCHING MOMENTS/ ROLLING MOMENTS

ABA: F.R.L.

ABS: A preliminary evaluation is made of the concept of vibration reduction by properly selected oscillatory collective and cyclic control applications. The investigations are based on experimental frequency response data covering advance ratios from approximately 0.2 to 0.85. Because there is no instrumentation for the measurement of the pitch and roll vibrations, these values were obtained by properly adding up the flap-bending moments at 3.3 in. Any other quantity representing pitch/roll vibrations can be compensated for in the same fashion. The calculated control inputs required for vibration reduction stay within acceptable limits. For four of the five conditions tested they are smaller than the values used for the frequency response tests. As to be expected, the compensating controls greatly affect the blade loads, i.e., torsion, flap, and chordwise bending.

474A37504*# ISSUE 18 PAGE 2540 CATEGORY 2
47/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Multicyclic jet-flap control for alleviation of helicopter blade stresses and fuselage vibration.


MAJS: / FORCED VIBRATION/ FUSELAGES/ JET FLAPS/ ROTARY WINGS/ VIBRATORY LOADS/ WIND TUNNEL TESTS

MINS: / BENDING VIBRATION/ HELICOPTER CONTROL/ OPTIMAL CONTROL/ ROTOR AERODYNAMICS/ ROTOR BLADES/ STRESS CONCENTRATION/ STRESS CYCLES/TRANSFER FUNCTIONS/ VERTICAL TAKEOFF AIRCRAFT

ABA: (Author)

ABS: Results of wind tunnel tests of a 12-meter diameter rotor utilizing multicyclic jet-flap control deflection are presented. Analyses of these results are shown, and experimental transfer functions are determined by which optimal control vectors are developed. These vectors are utilized to eliminate the specific harmonic bending stresses, minimize r.m.s. levels (a measure of the peak-to-peak stresses), or minimize vertical vibratory loads that would be transmitted to the fuselage. Although the specific results and the ideal control vectors presented are for a specific jet-flap driven rotor, the Cmethod is employed for the analyses is applicable to similar investigations. A discussion of possible alternative methods of multicyclic control by mechanical flaps or nonpropulsive jet-flaps is presented.
74A37497* ISSUE 1B PAGE 2540 CATEGORY 2
74/00/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: Theory and comparison with tests of two full-scale propellers

AUTH: W. J. COLLERON, W. PAA: A/(NASA Langley Research Center,
Large-Scale Aerodynamics Branch; U.S. Army, Air
Mobility R & D Laboratory, Moffett Field, Calif.)
In: Specialists Meeting on Rotorcraft Dynamics,
Proceedings. (A74-37481 10-02) Moffett Field, Calif.,

MAJS: /FULL SCALE TESTS/*MATHEMATICAL MODELS/*ROTOR
AERODYNAMICS/ TILTING ROTORS
MINS: /DEGREES OF FREEDOM/ GIBBS/L/ HELICOPTER DESIGN/
ROTOR BLADES/ ROTOR AIRCRAFT
ABA: (Author)

ABS: A nine-degrees-of-freedom theoretical model has been
developed for investigations of the dynamics of a prop
rotor operating in high inflow axial flight on a
cantilever wing. The theory is described, and the
results of the analysis are presented for two prop
rotor configurations: a gimbaled, stiff in-plane
rotor, and a hingeless, soft in-plane rotor. The
influence of various elements of the theory is
discussed, including the modeling used for the blade
and wing aerodynamics and the influence of the rotor
large degree of freedom. The results from full-scale
tests of the two prop rotors are presented and
compared with the theoretical results.

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74A37496* ISSUE 1B PAGE 2540 CATEGORY 2
74/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: An application of Floquet theory to prediction of
mechanical instability - for helicopter with
incompressible blade damper

AUTH: A/HAYWOOD, C. E. PAA: A/(U.S. Army, Air Mobility R &
D Laboratory, Fort Eustis; NASA Langley Research
Center, Hampton, Va.)
In: Specialists Meeting on Rotorcraft Dynamics,
Proceedings. (A74-37481 10-02) Moffett Field, Calif.,

MAJS: /AIRCRAFT STABILITY/FLOQUET THEOREM/HELICOPTER
DESIGN/HUBS/ROTOR AERODYNAMICS
MINS: /ANISOTROPIC MEDIA/ EQUATIONS OF MOTION/ MATRIX
METHODS/ MODAL RESPONSE/ ROTOR BLADES/ TIME RESPONSE/
VIBRATION DAMPING/ VIBRATION CODE
ABA: (Author)

ABS: The problem of helicopter mechanical instability is
considered for the case where one blade damper is
incoperative. It is shown that, if the hub is
considered to be nonisotropic, the equations of motion
have periodic coefficients which cannot be eliminated.

However, if the hub is isotropic, the equations can be
transformed to a rotating frame of reference and the
periodic coefficients eliminated. The Floquet matrix method is shown to be an effective
way of dealing with the nonisotropic hub and
nonisotropic rotor situation. Time history
calculations are examined and shown to be inferior to
the Floquet technique for determining system
stability.

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74A37486* ISSUE 1B PAGE 2539 CATEGORY 2
74/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Some approximations to the flapping stability
of helicopter rotors

AUTH: A/BIGGERS, J. C. PAA: A/(NASA Ames Research Center,
Moffett Field, Calif.)
In: Specialists Meeting on Rotorcraft Dynamics,
Proceedings. (A74-37481 10-02) Moffett Field, Calif.,
NASA Ames Research Center, 1974. 9 p.

MAJS: /AERODYNAMIC STABILITY/AIRCRAFT STABILITY/FLAPPING/
HELICOPTER DESIGN/ROTARY WINGS
MINS: /APPROXIMATION/ FLIGHT CHARACTERISTICS/ FLOQUET
THEOREM/ HOVERING STABILITY/ MATHEMATICAL MODELS/
PROCESSES (MATHEMATICS)/ PERTURBATION THEORY
ABA: (Author)

ABS: The flapping equation for a helicopter in forward
flight has coefficients which are periodic in time.
This fact complicates the calculation of
stability. This paper presents a constant coefficient
approximation which will allow the use of all the well
known methods for analyzing constant coefficient
equations. The flapping equation is first transformed
into the nonrotating coordinate frame, where some of
the periodic coefficients are transformed into
constant terms. The constant coefficient approximation
is then made by using time averaged coefficients in
the nonrotating frame. Stability calculations based on
the approximation are compared to results from a
theory which correctly includes all of the
periodicity. The comparison indicates that the
approximation is reasonably accurate at advance ratios
up to 0.5.

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74A37481* ISSUE 1B PAGE 2538 CATEGORY 2
74/00/00 306 PAGES UNCLASSIFIED DOCUMENT

UTTL: Specialists Meeting on Rotorcraft Dynamics, Moffett
Meeting sponsored by the American Helicopter Society
and NASA, Moffett Field, Calif., NASA Ames Research

MAJS: /CONFERENCES/HELICOPTER DESIGN/ROTOR AERODYNAMICS/*
ROTORTACT AERODYNAMIC STALLING/ AERODYNAMIC STABILITY/ AIRFOILS/ COMPLEX SYSTEMS/ FINITE ELEMENT METHOD/ FLAPPING/ FORCED VIBRATION/ FREE VIBRATION/ ROTOR BLADES/ TORSIONAL VIBRATION

ABA: J.W.K.

ABS: Analysis of specific problems in rotorcraft dynamics. Topics include hingeless rotor theory, dynamic stall modelling, periodic systems identification, analysis of complex systems with phase matrices, flapping stability, flap-lag dynamics at high advance ratios, finite element analysis and fueling free-vibration characteristics, coupled rotor/frame vibration methods, gust response characteristics with unsteady stall effects, antiresonance theory, cyclic feathering motions and dynamic loads, control load envelope shaping, rotor aerodynamics, use of Floquet theory, theory of propellers and tilt-rotors, two-bladed rotor, stability of aircraft and ground resonance, vertical-plane pendulum absorbers, multicyclic jet-flap control, engine/airframe interface, aircar, etc., and others. The minutes of the question and answer periods following the presentations are presented in the supplement. Individual items are announced in this issue.

74A366154 ISSUE 17 PAGE 2376 CATEGORY 2 RPT#: AHS PREPRINT 801 74/05/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: The prediction of rotor rotational noise using measured fluctuating blade loads

AUTH: A/HOSIER, R. N.; B/PEGG, R. J.; C/RAMAKRISHNAN, R.

MAJS: /AERODYNAMIC NOISE/ DATA REDUCTION/ NOISE GENERATORS/ NOISE SPECTRA/ ROTOR AERODYNAMICS/ TEST FACILITIES

MINS: /AERODYNAMIC NOISE/ DATA REDUCTION/ NOISE GENERATORS/ NOISE SPECTRA/ ROTOR AERODYNAMICS/ TEST FACILITIES

ABA: (Author)

ABS: The use of a two-color laser velocimeter to measure the flow velocities in the wake of a helicopter rotor is discussed, including methods for obtaining two components of both instantaneous and time-averaged velocities. Results are presented from an experiment using a 2.13-m-diameter model helicopter rotor operating at a tip speed ratio of 0.18 in a wind tunnel. The location of the tip vortex from the preceding blade was determined on the advancing side, and the diameter of the vortex core was found to be 15 percent of the blade chord (1.5 percent of the radius). The effects of the airfoil's bound vorticity were observed in the velocity distributions very near the blade. These effects suggest that the laser velocimeter may be used to determine the aerodynamic loading (circulation) at a spanwise station on the blade. Also the structure and boundary of the time-averaged wake were investigated.

74A366104 ISSUE 17 PAGE 2376 CATEGORY 2 RPT#: AHS PREPRINT 880 CNT#: NASS-11668 74/05/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Application of advanced composites to helicopter airframe structures -- CH-53 D materials

AUTH: A/RICH, M. J.; B/RIDGLEY, G. F.; C/LOKRY, D. W.
PAA: A/(United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.); B/(NASA); C/(United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.) SAP: MEMBERS $1.50; NONMEMBERS $2.00


MAJS: /AIRCRAFT MATERIALS/COMPOSITE MATERIALS/FUSELAGES/HELICOPTER DESIGN

TERMINAL 20 PAGE 26 (ITEMS 77-79 OF 130)
Elements of typical development programs are examined, and a comparison of fixed wing and rotary wing aircraft programs is presented. Proposed new test facilities for fixed wing aircraft and typical aircraft program costs are discussed, along with the use of wind tunnels for tilt rotor research aircraft and the role of 40 x 80 ft wind tunnels in tilt rotor aircraft development. Some changes in current programs and methods are outlined for bringing about desired improvements.

The dynamics of a helicopter blade in forward flight are described by a system of linear differential equations with periodic coefficients. The stability of this periodic aeroelastic system is determined, using multivariable Floquet-Liapunov theory. The transition matrix at the end of the period is evaluated by: (1) direct numerical integration, and (2) a new approximate method, which consists in approximating a periodic function by a series of step functions. The numerical accuracy and efficiency of the methods is compared, and the second method is shown to be superior by far. Results illustrating the effect of the periodic coefficients and various blade parameters are presented.

An experimental investigation was made of the Langley full-scale tunnel and outdoors to investigate some of the characteristics of vortex noise generated on a rotating-blade system. Acoustic measurements were made at several microphone positions for two different blade sections with several tip shapes and foil configurations. The blades were operated only at zero lift at each radial station, both for operating in their own wake and for operating with the wake blown downstream. Rotors with cylindrical blades generally created more noise throughout the noise spectrum than the rotor with NACA 0012 blades. Blowing the shed wake from the rotor with cylindrical blades did not have an appreciable effect on the frequency-amplitude spectrum. The tip shape changes had very little effect on the frequency-amplitude spectrum of the noise. Spoilers applied to the rotor with NACA 0012 blades increased the amplitude of the spectrum and decreased the number of harmonics of blade passage frequency.
jet-flap applications to helicopter rotors. The presented results of a wind-tunnel study, aimed at determining the jet-flap multicyclic control potential for vibratory load and stress relief, illustrate the types of control deflections involved and their effects. A demonstrated analysis technique, which is used to analyze these results, is believed to be applicable to many kinds of investigations, particularly where large numbers of variables are involved and where circumstances tend to preclude ‘systematic’ testing. Among the major results of the study is the finding that significant and substantial vibratory stress and load reductions are achievable with a jet-flap multicyclic control system.

An unsteady wake model for a hingeless rotor

A single nonsteady wake model derived from the unsteady moment of the momentum equation for zero advance ratio is correlated with cyclic pitch frequency response tests conducted with a small hingeless rotor model. Two and three or more blades are presented.

Description of a large scale rotor and its apparatus which were constructed to investigate the merits of
the St. Clair river, as part of NASA's program to develop an ice information system. The profiler described is a high resolution, nonimaging, short pulse radar, operating at a carrier frequency of 2.7 GHz. The system can resolve reflective surfaces separated by as little as 10 cm and permits measurement of the distance between resolvable surfaces with an accuracy of about 1 cm. Data samples are given for measurements both in a static (helicopter hovering) and a traverse mode. Ground truth measurements taken by an ice auger team traveling with the helicopter are compared with the remotely sensed data and the accuracy of the profiler is discussed based on these measurements.

73A11844+ ISSUE 2 PAGE 164 CATEGORY 2 CN#: NASA-6175 73/10/00 11 PAGES UNCLASSIFIED DOCUMENT

UTIL: Some conclusions regarding the aerelastic stability of hingeless helicopter blades in hover and in forward flight


MAJS: /AERODYNAMICS/AIRCRAFT STABILITY/HELICOPTER DESIGN/HOVERING STABILITY/RIGID ROTORS/ROTOR BLADES

MINS: /ASYMPTOTIC SERIES/EQUATIONS OF MOTION/FLAPS (CONTROL SURFACES)/ROTARY WINGS/TORSIONAL STRESS

ABA: (Author)

ABS: In this paper results and conclusions obtained from the study of the aerelastic instability of hingeless helicopter blades are presented. First, the large amplitude coupled flap-lag equations of motion of a hingeless elastic helicopter blade are solved using an asymptotic expansion procedure in multiple time scales. Both hover and forward flight cases are considered. Stability boundaries and amplitudes of nonlinear response are obtained. From these, the importance of the nonlinear coupling and the effect of the periodic coefficients is determined. Next, using a system of linearized coupled flap-lag-pitch equations in hover, various divergence mechanisms for hingeless blades are shown. Finally, the flutter boundaries for coupled flap-lag-pitch are obtained. The effect of the torsional degree of freedom on the flap-lag type of instability is investigated. Similarly the effect of lag on the flap-pitch type of instability is considered. In addition, the effect of various blade parameters on the stability boundaries is shown.

73A45264+ ISSUE 24 PAGE 3057 CATEGORY 2

UTIL: A comparison of the overall and broadband noise characteristics of full-scale and model helicopter rotors.


MAJS: /AERODYNAMICS/AIRCRAFT NOISE/BROADBAND/FULL SCALE TESTS/NOISE SPECTRA/ROTARY WINGS

MINS: /DIRECTIVITY/HELICOPTER DESIGN/NOISE GENERATORS/SOUND MODELS/SOUND PRESSURE

ABA: (Author)

ABS: The broadband noise generated by full-scale and model rotors is compared in terms of spectral content and the dependence on tip speed and rotor thrust/pitch angle. Low frequency broadband noise and high frequency broadband noise are studied separately and blade 'scalling' effects are outlined. The degree of agreement between measurements and theoretical and semi-empirical prediction methods is reviewed together with the directionality patterns. The parameters relating to the overall noise are also discussed. It is shown that in general good agreement is obtained between the full-scale and model rotors when comparing spectral content and the dependency of the noise levels on tip speed and thrust. The scaling factors usually considered applicable to the low frequency broadband noise do not, however, appear to apply to either the model or full scale rotors.

73A43134+ ISSUE 22 PAGE 2800 CATEGORY 2

UTIL: Non-linear flap-lag dynamics of hingeless helicopter blades in hover and in forward flight.


MAJS: /AERODYNAMIC STABILITY/AERODYNAMICS/HOVERING/RIGID ROTORS/ROTOR WINGS/ROTOR AERODYNAMICS

MINS: /CRITICAL LOADING/FLAPPING HINGES/HELICOPTER PERFORMANCE/NONLINEAR EQUATIONS

ABA: (Author)

ABS: The aerelastic instability of the coupled nonlinear flap-lag motion of a torsionally rigid helicopter blade is treated by using the perturbation method in multiple time scales. The nonlinearities present in the equations are those arising from the inclusion of
moderately large deflections in the inertia and aerodynamic loading terms. The stability boundaries, amplitudes of nonlinear response, and conditions for existence of limit cycles are obtained analytically. Thus the different roles played by the forcing, parametric excitation, and nonlinear coupling in affecting the solution can be easily identified. Numerical results illustrating the behavior of the blade are presented.

73A450BB* ISSUE 17 PAGE 2248 CATEGORY 32 RPT#: AHS PREPRINT 770 73/05/00 11 PAGES UNCLASSIFIED DOCUMENT

UUTL: Elastohydrodynamic principles applied to the design of helicopter components.


MAJS: /ELASTOHYDRODYNAMICS/HELICOPTER DESIGN/HELICOPTER PROPELLER DRIVE/LUBRICATION

MINS: /BALL BEARINGS/ COMPONENT RELIABILITY/ FILM THICKNESS /GEARS/ POWER TRANSMISSION/ SERVICE LIFE/ SLIDING FRICTION/ SURFACE ROUGHNESS/ SURFACE TEMPERATURE/TEMPERATURE EFFECTS

ABA: (Author)

ABS: Elastohydrodynamic principles affecting the lubrication of transmission components are presented and discussed. Surface temperatures of the transmission bearings and gears affect elastohydrodynamic film thickness. Traction forces and sliding as well as the inlet temperature determine surface temperatures. High contact ratio gears cause increased sliding and may run at higher surface temperatures. Component life is a function of the ratio of elastohydrodynamic film thickness to composite surface roughness. Lubricant starvation reduces elastohydrodynamic film thickness and increases surface temperatures. Methods are presented which allow for the application of elastohydrodynamic principles to transmission design in order to increase system life and reliability.

73A4506B* ISSUE 17 PAGE 2105 CATEGORY 2 RPT#: AHS PREPRINT 732 CN#: NAS2-4151 73/05/00 15 PAGES UNCLASSIFIED DOCUMENT

UUTL: On the question of adequate hingeless rotor modeling in flight dynamics.


MAJS: /AEROSTATICS/GEAR MODAL RESPONSE/ROTOR/ROTOR AERODYNAMICS/ROTOR BLADES/VIBRATION MODE

MINS: /AERODYNAMIC STABILITY/ ELASTIC PROPERTIES/ FLAPPLING/ FLIGHT MECHANICS/ GUST LOADS/ HUBS

ABA: (Author)

ABS: The somewhat controversial question of which elastic blade modes are essential in the flight mechanics of hingeless rotorcraft is studied on the basis of quasi-steady linear aerodynamics including reversed flow effects and uniform inflow. The modes are for the rotating back and internode aerodynamic coupling terms are retained. The criteria for judging elastic mode effects include 19 hub moment and force derivatives, rotor trim data, rotor stability charts for legged hub moment feedback. step gust and random
Quest responses. Fixed hub and constant chord blades with widely differing elasticity and inertia and with moderate twist are assumed.

73A26533* ISSUE 11 PAGE 1440 CATEGORY 32
RPT#: AIAA PAPER 73-404 CNT#: NGS-50-007-001
73/03/00 13 PAGES UNCLASSIFIED DOCUMENT
UTIL: Sensitivity of rotor blade vibration characteristics to torsional oscillations.
AUTH: A/BRATANOW, T.; B/ECER, A. PAA: B/Wisconsin University, Milwaukee, Wis.) SAP: MEMBERS, $1.50; NONMEMBERS, $2.00
MAJS: /DEGREES OF FREEDOM/DYNAMIC RESPONSE/HELICOPTER DESIGN/ROTOR BLADES/TORSIONAL VIBRATION
MINS: /AERODYNAMIC LOADS/ BENDING VIBRATION/VIBRATION DAMPING
ABA: (Author)
ABS: A theoretical investigation of dynamic response characteristics of helicopter rotor blades in forward flight was carried out with special emphasis on the torsional degrees-of-freedom. The finite element method was applied in the formulation of the coupled equations of motion for flapwise bending and torsion for blades with non-collinear elastic, mass and aerodynamic axes. The sensitivity of blade vibration characteristics with respect to structural, geometric and aerodynamic properties as well as flight conditions was evaluated. Numerical results for sample blades were plotted to show the variation of the coupling between bending and torsional components of the response.
73621710* ISSUE 8 PAGE 961 CATEGORY 13 CNT#:
NASA ORDER 0-03-00-002 72/00/00 17 PAGES
UNCLASSIFIED DOCUMENT

UTTIL: The utility of a low flying aircraft or helicopter
when collecting ground data for regional resource
surveys.

AUTH: A/RAUER, D. T. PAA: A/(California University, Berkeley, Calif.)
In: American Society of Photogrammetry and American
Congress of Surveying and Mapping, Fall Convention,
Columbus, Ohio, October 11-14, 1972. Proceedings,
(A77-21701 08-14) Falls Church, Va., American Society
of Photogrammetry. 1972, p. 367-369. NASA-supported
research.

MAJS: /AERIAL PHOTOGRAPHY/ EARTH RESOURCES SURVEY AIRCRAFT
/GROUND TRUTH/HELICOPTERS/PHOTOINTERPRETATION
MINS: /AGRICULTURE/ CROP GROWTH/ DATA ACQUISITION/ IMAGERY/
LAND USE/ PHOTOMAPPPING/ REMOTE SENSORS/ SNOW COVER

73188819* ISSUE 6 PAGE 682 CATEGORY 10 CNT#:
NGL-07-002-002 73/00/00 3 PAGES UNCLASSIFIED
DOCUMENT

UTTIL: Application of pole-placement theory to helicopter
stabilization systems.

AUTH: A/GARCIA, B.; B/LENGOFF, D. P. PAA: E/(Connecticut University, Storrs, Conn.)
In: Hawaii International Conference on System
Proceedings. (A73-18801 06-10) North Hollywood,

MAJS: /HELMICRAFT STABILITY/CH-46 HELICOPTER/COMPLEX
SYSTEMS/ FEEDBACK CONTROL/HELICOPTER CONTROL
MINS: /CONTROL STABILITY/ CONTROL THEORY/ EIGENVALUES/
EQUATIONS OF MOTION/ LEAST SQUARES METHOD
/LINEARIZATION/ NONLINEAR EQUATIONS/ OPTIMAL CONTROL/
STATE VECTORS

ABA: (Author)

ABS: This paper is concerned with the problem of designing
a controller for a complex dynamical system using
output feedback. The system selected for the study is
the Boeing Vertol CH-46 tandem rotor helicopter.
Feedback gains are obtained by least square solution
of the nonlinear equations derived from pole-placement
theory.

73417616* ISSUE 6 PAGE 647 CATEGORY 2 CNT#:
AIAA PAPER 73-27 73/01/00 14 PAGES UNCLASSIFIED
DOCUMENT

UTTIL: Research on future short-haul aircraft at the NASA
Langley Research Center.

Research Center, Low-Speed Aircraft Div., Hampton,
The objective of this experimental and theoretical investigation was to determine what factors and mechanisms are involved in vortex interaction and instability and how these phenomena manifest themselves. To answer these questions, the schlieren method of flow visualization was used to observe the wakes generated by two- and four-bladed model propellers and rotors. A concurrent free-wake analysis was conducted for comparative purposes. Schlieren pictures showing wake asymmetry and instability are presented. Various factors and mechanisms believed to be responsible for these are discussed along with the effects produced by the number of blades, collective pitch, and tip speed. Free-wake calculations that qualitatively confirm these factors responsible for wake asymmetry and interaction are also presented.
boundaries were found to be approximately valid in moderate turbulence for both VFR and IFR flight conditions. In negligible turbulence, the specified VFR level 2 boundary was also approximately valid but the Level 1 boundary was found to be too stringent.

Pilot rating gradients with damping were more apparent than with frequency for the range investigated.

72A25413# ISSUE 11 PAGE 1574 CATEGORY 2 RPT#: AIAA PAPER 72-392 CNT#: NAS1-10459 72/04/00 7 PAGES UNCLASSIFIED DOCUMENT

UNOC: Fatigue strength characteristics of boron-epoxy reinforced Al stringers for helicopter airframe


MAJS: /*AIRFRAME MATERIALS/*ALUMINUM/*BORON/*EPoxy RESINS/*FATIGUE LIFE/*HELICOPTER DESIGN

MINS: /CONFERENCES/ FAILURE MODES/ MECHANICAL PROPERTIES/ REINFORCED PLASTICS/ REINFORCEMENT (STRUCTURES)/ SHEAR STRESS/ STRINGERS/ TENSILE TESTS

ABA: (Author)

ABS: The airframe of a large helicopter generally requires additional stiffening for dynamic tuning to prevent resonance with the rotor vibratory forces. Investigations showed that aluminum stringers reinforced with boron-epoxy offered substantial weight saving for the CH54B Skycrane helicopter to achieve the required airframe stiffness. As a result, a program has been conducted under a NASA contract to design, test, and evaluate the static and fatigue strength characteristics of the composite reinforcement. The results of this phase of the effort will be reported in this paper.

72A15774# ISSUE 5 PAGE 611 CATEGORY 2 72/01/00 5 PAGES UNCLASSIFIED DOCUMENT

UNOC: Civil aircraft technological constraints and requirements, discussing noise, congestion and performance characteristics of rotorcraft, STOL, VTOL, hypersonic and supersonic transports


MAJS: /*AIRCRAFT NOISE/*AIRCRAFT PERFORMANCE/*CIVIL AVIATION

MINS: /TECHNOLOGY ASSESSMENT/*TRANSPORT AIRCRAFT

ABA: (Author)

ABS: Noise and congestion present the two main technological constraints on air-transportation growth. Although some of the noise reduction will come with improved flight-path control and steep approaches, the main requirement remains quiet propulsion systems. Higher engine temperatures will compensate for efficiency losses due to noise suppression. Composite structures can reduce structural weight by 20%. New developments in rotorcraft transports are discussed together with advanced subsonic transports of the 1980s and the possibilities for further evolution of the STS leading to a hypersonic aircraft.

71A41500# ISSUE 22 CATEGORY 1 RPT#: AIAA PAPER 71-581 CNT#: DAAj02-D070-C-C009 DAAj02-D069-C-D056 DAAj02-D069-C-C039 NAS1-8350 71/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UNOC: Wake and boundary layer effects in helicopter rotor aerodynamics

AUTH: (Author)

ABS: The new civil aviation within our grasp.

72A15774# ISSUE 5 PAGE 611 CATEGORY 2 72/01/00 5 PAGES UNCLASSIFIED DOCUMENT

UNOC: Civil aircraft technological constraints and requirements, discussing noise, congestion and performance characteristics of rotorcraft, STOL, VTOL, hypersonic and supersonic transports


MAJS: /*AIRCRAFT NOISE/*AIRCRAFT PERFORMANCE/*CIVIL AVIATION

MINS: /TECHNOLOGY ASSESSMENT/*TRANSPORT AIRCRAFT

ABA: (Author)

ABS: Noise and congestion present the two main technological constraints on air-transportation growth. Although some of the noise reduction will come with improved flight-path control and steep approaches, the main requirement remains quiet propulsion systems. Higher engine temperatures will compensate for efficiency losses due to noise suppression. Composite structures can reduce structural weight by 20%. New developments in rotorcraft transports are discussed together with advanced subsonic transports of the 1980s and the possibilities for further evolution of the STS leading to a hypersonic aircraft.

71A41500# ISSUE 22 CATEGORY 1 RPT#: AIAA PAPER 71-581 CNT#: DAAj02-D070-C-C009 DAAj02-D069-C-D056 DAAj02-D069-C-C039 NAS1-8350 71/08/00 16 PAGES UNCLASSIFIED DOCUMENT

UNOC: Wake and boundary layer effects in helicopter rotor aerodynamics

AUTH: (Author)

ABS: The new civil aviation within our grasp.

72A15774# ISSUE 5 PAGE 611 CATEGORY 2 72/01/00 5 PAGES UNCLASSIFIED DOCUMENT

UNOC: Civil aircraft technological constraints and requirements, discussing noise, congestion and performance characteristics of rotorcraft, STOL, VTOL, hypersonic and supersonic transports

AERODYNAMIC LOADS/HELCOPER WAKES/INFLUENCE COEFFICIENT/*MATHEMATICAL MODELS/ROTARY WINGS

MINS: / COMPUTER PROGRAMS/ CONFERENCES/ FLOW GEOMETRY/ FLOW VELOCITY/ FREE FLOW/ VORTICES

71A31083* ISSUE 14 PAGE 2178 CATEGORY 2 RPT#: AHS PREPRINT 512 CNT#: NAS2-4151 71/05/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: The method of multiblade coordinates in the linear analysis of lifting rotor dynamic stability and gust response at high advance ratio

UNOC: High rotor advance ratio from multiblade general coordinates method in linear analysis of lifting rotor dynamic stability and gust ratio


MAJS: /AEROELASTICITY/ AIRSPEED/ CONFERENCES/ CONTROL STABILITY/ FEATHERING/ GYROS/HELICOPTER PERFORMANCE/ HUBS/ WIND TUNNELS

71A3108B* ISSUE 14 PAGE 2178 CATEGORY 2 RPT#: AHS PREPRINT 502 CNT#: NAS2-5160 71/05/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Horizontal stoppable rotor conversion

UNOC: Stiffened horizontal stoppable hingeless rotor conversion from helicopter to airplane flight speeds


MAJS: /AEROElasticity/*ROtARY WINGS

MINS: / AEROElasticity/ AIRSPEED/ CONFERENCES/ CONTROL STABILITY/ FEATHERING/ GYROS/HELICOPTER PERFORMANCE/ HUBS/ WIND TUNNELS

71A18423* ISSUE 6 PAGE 880 CATEGORY 11 71/01/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: An evaluation of low-visibility landing systems by simulation

UNOC: Helicopter automatic and manual low visibility landing systems evaluation by hybrid computer simulation


MAJS: /AIRCRAFT LANDING/*AUTOMATIC LANDING CONTROL/*/ HELICOPTERS/*LANDING SIMULATION/*LOW VISIBILITY/*MANUAL CONTROL

MINS: / ATTITUDE (INCLINATION)/ COMPUTERIZED SIMULATION/ GLIDE PATHS/ HYBRID COMPUTERS/ INSTRUMENT FLIGHT RULES

71A17515* ISSUE 5 PAGE 695 CATEGORY 1 70/00/00 43 PAGES UNCLASSIFIED DOCUMENT

UTTL: A review of rotating blade noise technology

UNOC: Rotating blade noise technology, discussing vehicles and components, noise nature, generation, reduction and prediction


MINS: /AEROElasticity/NOISE REDUCTION/*ROtARY WINGS
MINS: / CONFERENCES/ HELICOPTERS/ NOISE SPECTRA/ ROTARY WINGS/ TECHNOLOGIES

71A15421# ISSUE 4 PAGE 532 CATEGORY 2
70/00/00 6 PAGES UNCLASSIFIED DOCUMENT
U T I L : Measurements and analysis of vibration ride environments
UNOC: Air transportation systems ride vibration environments
AUTH: A/CATHERINES, J. J.; B/CLEVENSON, S. A. P A N: (AB/NASA, LANGLEY RESEARCH CENTER, HAMPTON, VA./)
NEW YORK, AMERICAN HELICOPTER SOCIETY, INC., IN-
AMERICAN HELICOPTER SOCIETY, AMERICAN INST. OF
AERONAUTICS AND ASTRONAUTICS, AND U. OF TEXAS, JOINT
SYMPOSIUM ON ENVIRONMENTAL EFFECTS ON VTOL DESIGNS,
ARLINGTON, TEX., NOV. 16-18, 1970. PROCEEDINGS.
/71-15401 04-02/
MAJS: /AIR TRANSPORTATION/ COMFORT/ FLIGHT CHARACTERISTICS
MINS: /HUMAN TOLERANCES/ VIBRATION MEASUREMENT

71A15406# ISSUE 4 PAGE 531 CATEGORY 2
70/00/00 13 PAGES UNCLASSIFIED DOCUMENT
U T I L : The effect of various operating parameters on the noise radiation patterns from a helicopter in forward flight
UNOC: Helicopter in-flight noise radiation pattern and spectra measurements for various operating parameters
AUTH: A/PEGG, R. J. P A N: (AA/NASA, LANGLEY RESEARCH CENTER, HAMPTON, VA./)
NEW YORK, AMERICAN HELICOPTER SOCIETY, INC., IN-
AMERICAN HELICOPTER SOCIETY, AMERICAN INST. OF
AERONAUTICS AND ASTRONAUTICS, AND U. OF TEXAS, JOINT
SYMPOSIUM ON ENVIRONMENTAL EFFECTS ON VTOL DESIGNS,
ARLINGTON, TEX., NOV. 16-18, 1970. PROCEEDINGS.
/71-15401 04-02/
MAJS: /ACOUSTIC MEASUREMENT/ AIRCRAFT NOISE/ FLIGHT TESTS/ HELICOPTERS/ NOISE SPECTRA/ RADIATION DISTRIBUTION
MINS: /AIRSPEED/ CONFERENCES/ NOISE REDUCTION/ ROTOR SPEED/ THRUST

71A15171* ISSUE 4 PAGE 529 CATEGORY 2 70/12/00
4 PAGES UNCLASSIFIED DOCUMENT
U T I L : History of NACA/NASA rotating-wing aircraft research, 1915-1970. IV Cont’d
UNOC: NACA/NASA rotary wing aircraft research, considering rotor loads and configurations, ground resonance, blade flutter and flapping, motion equations and VTOL
AUTH: A/GUSTAFSON, F. B. P A N: (AA/NASA, LANGLEY RESEARCH CENTER, HAMPTON, VA./)
VERTIFLITE. VOL. 16, P. 9-11. 30.
MAJS: /HELICOPTER DESIGN/ NASA PROGRAMS/ RESEARCH PROJECTS
MINS: / ROTARY WING AIRCRAFT

71A11137# ISSUE 1 PAGE 5 CATEGORY 2 70/11/00
4 PAGES UNCLASSIFIED DOCUMENT
UNOC: NACA/NASA rotating wing aircraft research history during 1955-1970 period, discussing wind tunnel
AUTH: A/GUSTAFSON, F. B. P A N: (AA/NASA, LANGLEY RESEARCH CENTER, HAMPTON, VA./)
VERTIFLITE. VOL. 16, P. 6-9.
MAJS: / HELICOPTER DESIGN/ HISTORIES/ NASA PROGRAMS/ RESEARCH AND DEVELOPMENT/ ROTARY WING AIRCRAFT
MINS: / ROTOR AERODYNAMICS/ VERTICAL TAKEOFF AIRCRAFT/ WIND TUNNEL STABILITY TESTS

70A45519# ISSUE 24 PAGE 4291 CATEGORY 2 RPT:
AIAA PAPER 70-1262 70/10/00 10 PAGES UNCLASSIFIED DOCUMENT
U T I L : Aeronautical vehicles - 1970 and beyond
UNOC: Air transportation beyond 1970, discussing general aviation, short haul systems, VTOL, helicopter, V/STOL, subsonic, supersonic and hypersonic aircraft
AUTH: A/LUTFIN, L. K. JR. P A N: (LUTFIN, L. K. JR/NASA, LANGLEY RESEARCH CENTER, HAMPTON, VA./)
SAP: MEMBERS, $1.50. NONMEMBERS, $2.00.
NEW YORK, AMERICAN INST. OF AERONAUTICS AND
ASTRONAUTICS, AMERICAN INST. OF AERONAUTICS AND
ASTRONAUTICS. ANNUAL MEETING AND TECHNICAL DISPLAY,
MAJS: / AIR TRANSPORTATION/ TRANSPORT AIRCRAFT
MINS: / CONFERENCES/ GENERAL AVIATION AIRCRAFT/ HELICOPTERS/ HYPERSONIC AIRCRAFT/ SHORT HAUL AIRCRAFT/ SUPERSONIC AIRCRAFT/ V/STOL AIRCRAFT

70A44856# ISSUE 23 PAGE 417 CATEGORY 2
70/10/00 6 PAGES UNCLASSIFIED DOCUMENT
UNOC: NACA/NASA rotating wing aircraft research history 1915-1970. Part 3, covering rotor dynamics and flying qualities, hovering tests, rotor flow, loads, etc
AUTH: A/GUSTAFSON, F. B. P A N: (AA/NASA, LANGLEY RESEARCH CENTER, FLIGHT MECHANICS AND TECHNOLOGY DIV., HAMPTON, VA./)
MAJS: /*NASA PROGRAMS*/RESEARCH PROJECTS/*ROTARY WING AIRCRAFT/*ROTOR AERODYNAMICS
MINS: / AERODYNAMIC CHARACTERISTICS/ AERODYNAMIC LOADS/ DYNAMIC MODELS/ FLOW CHARACTERISTICS/ HOVERING STABILITY/ ROTARY WINGS/ STRESS ANALYSIS/ TEST FACILITIES

70A44853* ISSUE 23 PAGE 4142 CATEGORY 2
70/09/00 4 PAGES UNCLASSIFIED DOCUMENT
UNOC: NASA/NASA rotating wing aircraft research history 1915-1970. Part 3, covering rotor and helicopter theory, related flight and wind tunnel testing, etc
VERTITLIE VOL. 16, P. 10, 11, 14, 15.
MAJS: /*FLIGHT TESTS*/NASA PROGRAMS/*RESEARCH PROJECTS/* ROTARY WING AIRCRAFT/*WIND TUNNELS
MINS: / AERODYNAMIC CHARACTERISTICS/ AERODYNAMICS/ AIRCRAFT STABILITY/ AUTOROTATION/ FLOW CHARACTERISTICS/ GROUND EFFECT/ HELICOPTER CONTROL/ HELICOPTERS/ HISTORIES/ ROTOR AERODYNAMICS

70A44862* ISSUE 23 PAGE 4142 CATEGORY 2
70/07/00 4 PAGES UNCLASSIFIED DOCUMENT
UNOC: NASA/NASA rotating wing aircraft research history 1915-1970. Part 2, covering autogyro flight test experiences, rotor blade dynamics research, interest in helicopters, etc
VERTITLIE VOL. 16, P. 10, 11, 14, 15.
MAJS: /*DYNAMIC CHARACTERISTICS*/NASA PROGRAMS/*RESEARCH PROJECTS/*ROTARY WING AIRCRAFT/*ROTOR BLADES
MINS: / AUTOGYROS/ FLIGHT TESTS/ GROUND TESTS/ HELICOPTER DESIGN/ HISTORIES/ PRODUCT DEVELOPMENT

70A44867* ISSUE 23 PAGE 4142 CATEGORY 2
70/06/00 8 PAGES UNCLASSIFIED DOCUMENT
UNOC: NASA/NASA rotating wing aircraft research covering autogyro and helicopter development, noting flight safety
VERTITLIE VOL. 16, P. 4-11.
MAJS: /*AUTOGYROS*/HELICOPTER DESIGN/*NASA PROGRAMS
MINS: / CONFERENCES/ FLIGHT SAFETY/ ROTARY WINGS/ WIND TUNNELS

70A44323* ISSUE 23 PAGE 4120 CATEGORY 2
70/10/00 8 PAGES UNCLASSIFIED DOCUMENT
UTTL: A note on a phenomenon affecting helicopter directional control in rearward flight
UNOC: Main rotor wake adverse effects on tail rotor directional control in low velocity wind
AUTH: A/HUSTON, R. J.; B/DUROUS, C. E.; J.; PAN: (AB/NASA, Langley Research Center, Hampton, VA.)
AMERICAN HELICOPTER SOCIETY, JOURNAL, VOL. 15, P. 38-45.
MAJS: /*DIRECTIONAL CONTROL*/HELICOPTER CONTROL/*HELICOPTER MAKES/*ROTARY WINGS/*TAIL ASSEMBLIES
MINS: / AIRSPEED/ CONFERENCES/ FREE FLOW/ TORQUE/ VORTICES/ WIND VELOCITY

70A39582* ISSUE 20 PAGE 3550 CATEGORY 1 RPT: AIAA PAPER 70-945 70/08/00 9 PAGES UNCLASSIFIED DOCUMENT
UTTL: Dynamic stall simulation problems
UNOC: Dynamic airfoil stall simulation in wind tunnels, considering pitch rate, Reynolds number, oscillation and test equipment effects
MAJS: /*AERODYNAMIC STALLING*/AIRFOILS/*DYNAMIC MODELS/*WIND TUNNEL MODELS
MINS: / AERODYNAMIC COEFFICIENTS/ COMPRESSORS/ FLUTTER/ HELICOPTERS/ LAMINAR FLOW/ LEADING EDGES/ PITCHING MEGNITUDE/ REYNOLDS NUMBER/ SPACE SHUTTLES/ TRAILING EDGES/ TURBULENCE EFFECTS

70A34750* ISSUE 17 PAGE 3016 CATEGORY 2
70/06/00 14 PAGES UNCLASSIFIED DOCUMENT
UTTL: Helicopter rotor periodic differential pressures and structural response measured in transient and steady-state maneuvers
UNOC: Helicopter rotor blade differential pressure and structural load characteristics in transient and steady state maneuvers
AUTH: A/WARD, J. F. PAN: (AA/NASA, Langley

TERMINAL 20 PAGE 38 (ITEMS 120-125 OF 130)
RESEARCH CENTER, FLIGHT MECHANICS AND TECHNOLOGY DIV., HAMPTON, VA./.) SAP: MEMBERS, $1.25, NONMEMBERS, $2.00.
NEW YORK, AMERICAN HELICOPTER SOCIETY, AMERICAN HELICOPTER SOCIETY, ANNUAL NATIONAL FORUM, 26TH, WASHINGTON, D.C., JUN. 16-18, 1970.
MAJS: /*AERODYNAMIC LOADS/*HELICOPTER PERFORMANCE/*MANEUVERS /*ROTARY WINGS
MINS: /*CONFERENCES/FLIGHT RECORDERS/STRUCTURAL STRAIN/TRANSIENT RESPONSE

70A34737* ISSUE 17 PAGE 3009 CATEGORY 1 CNT#: NGR-39-009-111 70/06/00 12 PAGES UNCLASSIFIED DOCUMENT
UTTL: A study of rotor blade-vortex interaction
UNOC: Surface pressure and lift measurement on model lifting rotor blade as function of vortex interaction, using flush mounted pressure transducers
AUTH: /MECCHNICK, B. W., JR.; /SIBLEY, H. M. PAN: (AA/sovNVASIA STATE U., UNIVERSITY PARK, PA./.) SAP: MEMBERS, $1.25, NONMEMBERS, $2.00.
NEW YORK, AMERICAN HELICOPTER SOCIETY, AMERICAN HELICOPTER SOCIETY, ANNUAL NATIONAL FORUM, 26TH, WASHINGTON, D.C., JUN. 16-18, 1970.
MAJS: /*LIFTING ROTORS/PRESSURE MEASUREMENT/*VORTEX GENERATORS
MINS: /*CONFERENCES/HELICOPTER DESIGN/PRESSURE SENSORS/ROTARY WINGS

70A34730* ISSUE 17 PAGE 3199 CATEGORY 34 CNT#: NSR-05-020-151 70/06/00 10 PAGES UNCLASSIFIED DOCUMENT
UTTL: Metropolitan air transit system
UNOC: Computerized metropolitan air transit system, discussing system redundancy for safety level maintenance and all-weather dependability
AUTH: /ANDREGLI, A. E. PAN: (AA/STANFORD U., STANFORD, CALIF./.) SAP: MEMBERS, $1.25, NONMEMBERS, $2.00.
NEW YORK, AMERICAN HELICOPTER SOCIETY, AMERICAN HELICOPTER SOCIETY, ANNUAL NATIONAL FORUM, 26TH, WASHINGTON, D.C., JUN. 16-18, 1970.
MAJS: /*AIR TRANSPORTATION/*REDUNDANT COMPONENTS/*SYSTEMS ENGINEERING/*URBAN TRANSPORTATION
MINS: /*ALL-WEATHER AIR NAVIGATION/*COMPUTER PROGRAMS/*CONFERENCES/*COST ANALYSIS/*HELICOPTER DESIGN/*RAPID TRANSIT SYSTEMS

70A34704* ISSUE 17 PAGE 3013 CATEGORY 2 CNT#: NAS-7-880 70/06/00 13 PAGES UNCLASSIFIED DOCUMENT
UTTL: Simplified procedures for estimating flapwise bending moments in helicopter rotor blades
UNOC: Helicopter rotor blades flapwise bending moments prediction by transfer function/superposition techniques
AUTH: /LANDGREBE, A. J. PAN: (AA/UNITED AIRCRAFT RESEARCH LABS., EAST HARTFORD, CONN./.) SAP: MEMBERS, $1.25, NONMEMBERS, $2.00.
NEW YORK, AMERICAN HELICOPTER SOCIETY, AMERICAN HELICOPTER SOCIETY, ANNUAL NATIONAL FORUM, 26TH, WASHINGTON, D.C., JUN. 16-18, 1970.
MAJS: /*BENDING MOMENTS/*PERFORMANCE PREDICTION/*ROTARY WINGS/*ROTARY AERODYNAMICS
MINS: /*CONFERENCES/DEGREES OF FREEDOM/FLAPPING/HELICOPTER DESIGN/SUPERPOSITION (MATHEMATICS)/TRANSFER FUNCTIONS

70A33318* ISSUE 15 PAGE 2043 CATEGORY 10 CNT#: 70/00/00 9 PAGES UNCLASSIFIED DOCUMENT
UTTL: A frequency-domain approach to handling qualities design
UNOC: Linear multivariable feedback control systems design method based on transfer matrix, testing decoupling desirability
MAJS: /*FEEDBACK CONTROL/*LINEAR SYSTEMS/*MATRICES (MATHEMATICS)/SYSTEMS ENGINEERING/*TRANSFER FUNCTIONS
MINS: /*CONFERENCES/CONTROL STABILITY/DECOUPLING/*FREQUENCY RESPONSE/HELICOPTER DESIGN/MATHEMATICAL MODELS

70A29622* ISSUE 13 PAGE 2449 CATEGORY 21 70/05/00 9 PAGES UNCLASSIFIED DOCUMENT
/FOR ABSTRACT SEE ISSUE 01, PAGE 136 ACCESSION NO. A70-10303/
UTTL: Flight test experiments to evaluate aided inertial system performance for terminal guidance
UNOC: Flight test experiments for H-19 helicopter to evaluate aided inertial system performance for terminal guidance
AUTH: /HADIGAN, K. J. PAN: (AA/NASA, ELECTRONICS RESEARCH CENTER, CAMBRIDGE, MASS./.) NAVIGATION. VOL. 17, P. 83-91. /INST. OF NAVIGATION.
deployment of its resources. NASA should consider societal benefits as well as the military and civil markets in formulating the role it can play to support the development of a stronger rotorcraft technology base.

B2N19172# ISSUE 10 PAGE 1318 CATEGORY 2 RPT#: NASA-TM-84146 80/12/05 149 PAGES UNCLASSIFIED DOCUMENT
CORP: National Aeronautics and Space Administration.
WASHINGTON, D.C. AVAIL. NTIS SAP: HC AO7/MA AO1
Workshop held at Palo Alto, Calif. 2-5 Dec. 1980
MAJS: /HELIPIER DESIGN/HELIPIER ENGINES/HELIPIER PERFORMANCE/HELIPIER/SHORT TAKEOFF AIRCRAFT/
TECHNOLOGY ASSESSMENT/USER REQUIREMENTS
MINS: /CONFERENCES/PAPERS/PROCEEDINGS/RESEARCH/ROTARY WING AIRCRAFT/ TILTING ROTORS
ABA: L.F.M.

ABS: Helicopter user needs, technology requirements and status, and proposed research and development action are summarized. It is divided into three sections: flight dynamics and control; all weather operations; and human factors.

B2N19171# ISSUE 10 PAGE 1317 CATEGORY 2 RPT#: NASA-TM-84147 80/12/05 111 PAGES UNCLASSIFIED DOCUMENT
UTIL: NASA/HAA Advanced Rotorcraft Technology and Tilt Rotor Workshops. Volume 2: Operators' Views
CORP: National Aeronautics and Space Administration.
WASHINGTON, D.C. AVAIL. NTIS SAP: HC AO7/MA AO1
Workshop held at Palo Alto, Calif. 2-5 Dec. 1980
MAJS: /HELIPIER DESIGN/HELIPIER ENGINES/HELIPIER PERFORMANCE/HELIPIER/SHORT TAKEOFF AIRCRAFT/
TECHNOLOGY ASSESSMENT/USER REQUIREMENTS
MINS: /CONFERENCES/PAPERS/PROCEEDINGS/RESEARCH/ROTARY WING AIRCRAFT/ TILTING ROTORS
ABA: L.F.M.

ABS: A special panel of helicopter users give presentations in 12 basic areas of helicopter applications. Development of the helicopter and the needs for future growth are discussed.

PRINT 15/2/1-21 TERMINAL=20 B2N2320# ISSUE 14 PAGE 169B CATEGORY 3 RPT#: NASA-CP-2219 A-881 NAS 55-2219 02/04/00 243 PAGES UNCLASSIFIED DOCUMENT
UTIL: Helicopter Handling Qualities
CORP: National Aeronautics and Space Administration. Ames Research Center. Moffett Field, Calif. AVAIL. NTIS ROTOR SAP: HC AO7/MA AO1
Proceedings of the special meeting held at Moffett Field, Calif., 14-15 Apr. 1982; sponsored by the American Helicopter Society
MAJS: /AIRCRAFT SPECIFICATIONS/AVIONICS/COCKPITS/
COSTS/END/CONTROLLABILITY/HELIPIER CONTROL/ MANEUVERABILITY/MA/M-OF-THE-EARTH NAVIGATION/NIGHT FLIGHTS (AIRCRAFT)
MINS: /AIRCRAFT INSTRUMENTS/AIRCRAFT PNEUMATICS/AIRCRAFT RELIABILITY/AIRCRAFT SURVIVABILITY/ ALL-WEATHER AIR NAVIGATION/AUTOMATIC FLIGHT CONTROL/COMBAT/CONTROL BOARDS/DISPLAY DEVICES/FLIGHT CONTROL/HELIPER PERFORMANCE/RADAR NAVIGATION/STABILITY AUGMENTATION
ANN: Helicopters are used by the military and civilian communities for a variety of tasks and must be capable of operating in poor weather conditions and at night. Accompanying extended helicopter operations is a significant increase in pilot workload and a need for better handling qualities. An overview of the status and problems in the development and specification of helicopter handling qualities criteria is presented. Topics for future research efforts by government and industry are highlighted. For individual titles, see N82-2.209 through N82-2320.

B2N26362# ISSUE 17 PAGE 2283 CATEGORY 1 RPT#: NASA-CR-164517 CR#: NASA-3455 NASA-2342 81/00/00 7 VOLS 39 PAGES UNCLASSIFIED DOCUMENT
UTIL: NASA's Role in Aeronautics: A Workshop. Volume 5: Rotorcraft
Workshop held at Woods Hole, Mass. 27 Jul. - 2 Aug. 1980
MAJS: /AERONAUTICAL ENGINEERING/CONFERENCES/NASA PROGRAMS
/RESEARCH MANAGEMENT/ROTARY WING AIRCRAFT
MINS: /ACROACOUSTICS/DECISION/EMERGENCIES/FLIGHT CONTROL/ROTOR AERODYNAMICS
ABA: A.R.H.

ABS: The potential roles for NASA relating to rotorcraft are reviewed. The agency's participation is delineated for each role, a rationale is provided for the current level of activity is summarized, and suggestions are given for the kinds of research still needed. In examining opportunities for the most beneficial
This presentation provides an overview of the NASA Rotorcraft Program as an introduction to the technical sessions of the Advanced Rotorcraft Technology Workshop. It deals with the basis for NASA's increasing emphasis on rotorcraft technology, NASA's research capabilities, recent program planning efforts, highlights of its 10-year plan and future directions and opportunities.
ABA: R.E.S.

ABS: Latest results of programs exploring new propulsion technology for powered-lift aircraft systems are presented. Topics discussed include results from the 'quiet, clean, short-haul experimental engine' program and progress reports on the 'Quiet Short-Haul Research Aircraft' and 'Tilt-Rotor Research Aircraft' programs. In addition to these NASA programs, the Air Force's YC-14 and YC-15 programs were reviewed.

79N23912# ISSUE 15 PAGE 1526 CATEGORY 2 RPT: NASA-CP-2086 FAIR-78-109 E-027 79/00/00 147 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aircraft icing
CORP: National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AVAIL NTIS SAP: HC A07/MF A01 Workshop held at Cleveland, 19-21 Jul, 1978

MAJS: / AIRCRAFT HAZARDS/ CONFERENCE/ ICE FORMATION
MINS: / HELICOPTERS/ METEOROLOGY/ SAFETY MANAGEMENT
ANN: The results of a conference on the problems of aircraft icing are reported. For individual titles, see N79-23913 through N79-23919.

79N24951# ISSUE 16 PAGE 2069 CATEGORY 1 RPT: NASA-TH-80541 78/10/15 189 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced rotorcraft technology task force report
CORP: National Aeronautics and Space Administration, Washington, D. C. AVAIL NTIS SAP: HC A09/MF A01

MAJS: / AERODYNAMICS/ AERODYNAMIC CHARACTERISTICS/ AIRCRAFT STRUCTURES/ HELICOPTER DESIGN/ ROTARY WING AIRCRAFT
MINS: / AIRFRAMES/ AVIONICS/ CIVIL AVIATION/ FLIGHT CONTROL/ MILITARY HELICOPTERS/ PROPULSION SYSTEM PERFORMANCE/ ROTOR AERODYNAMICS

ABA: A.C.L.

ABS: The technological needs and opportunities related to future civil and military rotorcraft were determined and a program plan for NASA research which was responsive to the needs and opportunities was prepared. In general, the program plan places the primary emphasis on design methodology where the development and verification of analytical methods is built upon a sound data base. The four advanced rotorcraft technology elements identified are aerodynamics and structures, flight control and avionics systems, propulsion, and vehicle configurations. Estimates of the total funding levels that would be required to support the proposed program plan are included.
MAJS: /AEROACOUSTICS/AIRCRAFT NOISE/CONFERENCES/Helicop ters
MINS: /SUPERTOY FATIGUE/HUMAN FACTORS ENGINEERING/NOISE REDUCTION/PREDICTION ANALYSIS TECHNIQUES/RO TARY WINGS/ROTOR AERODYNAMICS
ANN: Exterior and interior helicopter noise problems are addressed from the physics and engineering as well as the human factors point of view. Noise regulation concepts, human factors and criteria, rotor noise generation and control, design, operations and testing for noise control, helicopter noise prediction, and research tools and measurements are covered. For individual titles, see N79-10844 through N79-10864.

ANN: Military and civilian rotorcraft designers are provided with exchanges concerning common problems and grounds for civil/military cooperation. Sessions included military requirements and new rotorcraft systems: civil operations and new helicopter designs; and research vehicles. Rotor wind tunnel and flight research are also reviewed, and opportunities for coordinating military and civil requirements and specifications are discussed. For individual titles, see N76-1917 through N78-1915.

MAJS: /AIRCRAFT STRUCTURES/CONFERENCES/HÉLICOPTE RS DESIGN
MINS: /AIR TRANSPORTATION/ AERIAL PROFILES/ HELIPORTS/ NOISE POLLUTION/ NOISE REDUCTION/ POLLUTION CONTROL/ PREDICTION ANALYSIS TECHNIQUES/ REGULATIONS/ ROTARY WINGS/ ROTOR AERODYNAMICS/ URBAN DEVELOPMENT/ WIND TUNNEL TESTS
ANN: Exterior and interior noise problems are addressed both from the physics and engineering as well as the human factors point of view. The role of technology in closing the gap between what the customers and regulating agencies would like to have and what is available is explored. Noise regulation concepts, design, operations and testing for noise control, helicopter noise prediction, and research tools and measurements are among the topics covered. For individual titles, see N78-32617 through N78-32635.

MAJS: CHemeRING/AIRCRAFT DESIGN/HÉLICOPTE RS PERFORMANCE/ROTOR WING AIRCRAFT
MINS: /ARMED FORCES (FOREIGN)/ARMED FORCES (UNITED STATES)/CIVIL AVIATION/MILITARY HELICOPTERS/TECHNOLOGICAL FORECASTING
ANN: Military and civilian rotorcraft designers are provided with exchanges concerning common problems and grounds for civil/military cooperation. Sessions included military requirements and new rotorcraft systems: civil operations and new helicopter designs; and research vehicles. Rotor wind tunnel and flight research are also reviewed, and opportunities for coordinating military and civil requirements and specifications are discussed. For individual titles, see N76-1917 through N78-1915.

MAJS: /AEROCOUSTICS/AIRCRAFT NOISE/CONFERENCES/HÉLICOPTE RS
MINS: /AIR TRANSPORTATION/ AERIAL PROFILES/ HELIPORTS/ NOISE POLLUTION/ NOISE REDUCTION/ POLLUTION CONTROL/ PREDICTION ANALYSIS TECHNIQUES/ REGULATIONS/ ROTARY WINGS/ ROTOR AERODYNAMICS/ URBAN DEVELOPMENT/ WIND TUNNEL TESTS
ANN: Exterior and interior noise problems are addressed both from the physics and engineering as well as the human factors point of view. The role of technology in closing the gap between what the customers and regulating agencies would like to have and what is available is explored. Noise regulation concepts, design, operations and testing for noise control, helicopter noise prediction, and research tools and measurements are among the topics covered. For individual titles, see N78-32617 through N78-32635.
design approach using advanced composites.

74N20756# ISSUE 12 PAGE 1395 CATEGORY 5 RPT#: AGARD-CP-134 7/02/00 121 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Escape problems and manoeuvres in combat aircraft — conference on aircraft escape systems for helicopters and V/STOL aircraft

MAJS: /AIRCRAFT EQUIPMENT/CONFERENCES/EJECTION SEATS/
ESEQE SYSTEMS
MINS: / HUMAN FACTORS ENGINEERING/ HUMAN TOLERANCES/ LIFE SUPPORT SYSTEMS/ SAFETY DEVICES
ANN: The proceedings of a conference on the subject of problems of escape from rotary wing and V/STOL aircraft are presented. The purpose of the meeting was to delineate the important aspects of the escape problems and to review new concepts in escape technology. The subjects covered were broad ranging from biomedical issues in air combat mishaps in high performance aircraft to human factors and engineering aspects of inflight escape in all types of aircraft.

74A37481# ISSUE 18 PAGE 2538 CATEGORY 2 7/04/00 386 PAGES UNCLASSIFIED DOCUMENT

MAJS: /CONFERENCES/HELICOPTER DESIGN/ROTOR AERODYNAMICS/ROTORCRAFT AIRCRAFT
MINS: / AERODYNAMIC STALLING/ AEROELASTICITY/ AIRFRAMES/ COMPLEX SYSTEMS/ FINITE ELEMENT METHODS/ FLAPPING/ FORCED VIBRATION/ FREE VIBRATION/ ROTOR BLADES/ TORSIONAL VIBRATION
ABA: J.K.K.

ABS: Analysis of specific problems in rotorcraft dynamics. Topics include hingeless rotor theory, dynamic stall modeling, periodic systems identification, analysis of complex systems with phasing matrices, flapping stability, flap-lag dynamics at high advance ratios, finite element analysis and fuselage free vibration characteristics, coupled rotor/frame vibration methods, gust response characteristics with unsteady stall effects, antiresonance theory, cyclic feathering motions and dynamic loads, control load envelope shaping, rotor aerelasticity, use of Floquet theory, theory of propellers and tilt-rotors, two-bladed teetering rotors, stability of air and ground resonance, vertical plane pendulum absorbers, multicyclic jet-flap control, engine/frame interface dynamics, and others. The minutes of the question and answer periods following the presentations are presented in the supplement. Individual items are announced in this issue.

74N34483# ISSUE 24 PAGE 2901 CATEGORY 2 RPT#: NASA-SP-352 7/04/00 370 PAGES UNCLASSIFIED DOCUMENT

UTTLE: Rotorcraft dynamics
CORP: National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. AVAIL.NTIS SPAC: HC $8.00
MAJS: /CONFERENCES/ROTOR AERODYNAMICS/ROTORCRAFT AIRCRAFT
MINS: / DYNAMIC STRUCTURAL ANALYSIS/ HELICOPTERS/ LOADS (FORCES)/ ROTARY WINGS/ VIBRATION
ANN: The dynamic structural analysis of rotary winged aircraft is reported, considering helicopter vibration and loads.