AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES
INTRODUCTION

This issue of Aerospace Medicine and Biology (NASA SP-7011) lists 305 reports, articles and other documents originally announced in September 1992 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The first issue of Aerospace Medicine and Biology was published in July 1964.

Accession numbers cited in this issue are:

- STAR (N-10000 Series) N92-28223 — N92-30232
- IAA (A-10000 Series) A92-44895 — A92-49229

In its subject coverage, Aerospace Medicine and Biology concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by STAR categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract, report number, and accession number—are included.


Information on availability of documents listed, addresses of organizations, and CASI price schedules are located at the back of this issue.
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TYPICAL REPORT CITATION AND ABSTRACT

A comprehensive study to develop software to simulate the dynamic operation of water reclamation systems in long-term closed-loop life support systems is being carried out as part of an overall program for the design of systems for a moon station or a Mars voyage. This project is being done in parallel with a similar effort in the Department of Chemistry to develop durable accurate low-cost sensors for monitoring of trace chemical and biological species in recycled water supplies. Aspen-Plus software is being used on a group of high-performance work stations to develop the steady state descriptions for a number of existing technologies. Following completion, a dynamic simulation package will be developed for determining the response of such systems to changes in the metabolic needs of the crew and to upsets in system hardware performance.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

Results are reported from an experimental study tracing the effects of hypoxia on thermoregulation and on the different sources of thermogenesis in rats before and after periods of 1-4 wk of cold acclimation. Measurements of the metabolic rate (VO2) and body temperature (Tb) were made at 5-min intervals, and shivering activity was recorded continuously in groups of rats subjected to three protocols. Recordings were made in normoxia and in hypoxia on different days in the same animals. The results show that: (1) in noncold-acclimated (NCA) rats, cold exposure induced increases in VO2 and shivering that were proportional to the decrease in Ta; (2) in cold-acclimated (CA) rats in normoxia, for a given ambient temperature, VO2 and Tb were higher than in NCA rats, whereas shivering was generally lower; and (3) in both NCA and CA rats, hypoxia induced a transient decrease in shivering and a sustained decrease in nonshivering thermogenesis associated with a marked decrease in Tb that was about the same in NCA and CA rats. It is concluded that hypoxia acts on Tb control to produce a general inhibition of thermogenesis.

P.D.
A92-45817
EFFECT OF HYPOBARIC HYPOXIA ON FIBER TYPE COMPOSITION OF THE SOLEUS MUSCLE IN THE DEVELOPING RAT
M. ITOH, K. ITOH, S. TAGUCHI, C. HIROFUJI, H. TAKEUCHI, and A. ISHIHARA (Kyoto University, Japan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 7, July 1992, p. 583-587. refs
Copyright
The fiber type composition of the soleus muscle was investigated in male Sprague-Dawley rats exposed to hypobaric hypoxia of 460 mm Hg from 5 to 12 weeks of age. The muscle fibers were classified as fast-twitch oxidative (FO) and slow-twitch (S) on the basis of adenosine triphosphatase (ATPase) and succinate dehydrogenase (SDH) reactions. Intermediate fibers (INT) with intermediate ATPase and high SDH reaction intensities were also examined. A type shift of muscle fibers from FO to INT and S was found in the control group during development. After exposure to hypoxia, the hypoxia group had a significantly greater percentage of FO fibers than the age-matched control group. There was no significant change in the total number of fibers in the muscle during development and after exposure to hypoxia. These results indicate that the increased percentage of FO fibers found in the developing rat under hypoxic conditions is due to a hypoxia-induced inhibition of the type shift of muscle fibers from FO to S during development. Author

A92-45949
OBSERVATION OF DYNAMIC CHANGES OF RAT SOLEUS DURING TAIL SUSPENSION
JUN-MING ZHU (Institute of Space Medico-Engineering, Beijing, People's Republic of China) Space Medicine & Medical Engineering (ISSN 1002-0837), vol. 5, no. 1, 1992, p. 49-54. In Chinese. refs
Copyright
The effect of tail suspension for varying time on the weight, protein content, and biomechanical parameters of rat's soleus was investigated in rats subjected to hypobaric hypoxia of 460 mm Hg from 5 to 12 weeks of age. The muscle fibers were classified as fast-twitch oxidative (FO) and slow-twitch (S) on the basis of adenosine triphosphatase (ATPase) and succinate dehydrogenase (SDH) reactions. Intermediate fibers (INT) with intermediate ATPase and high SDH reaction intensities were also examined. A type shift of muscle fibers from FO to INT and S was found in the control group during development. After exposure to hypoxia, the hypoxia group had a significantly greater percentage of FO fibers than the age-matched control group. There was no significant change in the total number of fibers in the muscle during development and after exposure to hypoxia. These results indicate that the increased percentage of FO fibers found in the developing rat under hypoxic conditions is due to a hypoxia-induced inhibition of the type shift of muscle fibers from FO to S during development. Author

A92-45983
MULTIPLE DIPOLE MODELING AND LOCALIZATION FROM SPATIO-TEMPORAL MEG DATA
JOHN C. MOSHER (TRW, Inc., Systems Engineering and Development Div., Redondo Beach; Southern California, University, Los Angeles, CA), PAUL S. LEWIS (Los Alamos National Laboratory, NM), and RICHARD M. LEAHY (Southern California, University, Los Angeles, CA) IEEE Transactions on Biomedical Engineering (ISSN 0018-9294), vol. 39, no. 6, June 1992, p. 541-557. Research supported by TRW, Inc. and University of Southern California. refs (Contract W-7405-ENG-36) Copyright
General descriptive models for spatiotemporal magnetoencephalogram (MEG) data are presented and the separability of the linear moment parameters and nonlinear location parameters in the MEG problem are shown. A forward model with current dipoles in a spherically symmetric conductor is used as an example. A subspace methodology and computational approach to solving the conventional least-squares problem is presented. A new scanning approach equivalent to the statistical MUSIC method is developed. This subspace method scans 3D space with a one-dipole model, making it computationally feasible to scan the computer head volume. It is shown how PCA dipole fitting fails while the new scanning method generally succeeds. C.D.
The effect of an exposure to a weak (30 microT) magnetic field of low-frequency (0.08 and 8 Hz) on the dynamics of lipid peroxidation and the content of total thiol groups in the brain of mice was investigated. It is shown that exposures to magnetic fields cause changes in the time organization and in interrelations of the redox processes, which depend on the magnetic-field frequency.

I.S.

A92-46603

EFFECT OF THE BLOCKING OF BETA RECEPTORS ON THE STATE OF THE LYSOSOMAL APPARATUS IN NEUTROPHILIC LEUKOCYTES IN THE PERIPHERAL BLOOD OF RABBITS SUBJECTED TO IMMOBILIZATION STRESS [PVLIV BLOKADI BETA-RESEPTORIV NA STAN LIZOSOMAL'NOGO APARATU NEITROFIL'NIKH LEIKOTITIV PERIFERICHNOI KROVI KROVIV PRI IMMOBILIZATSII (DOMOMU STRESI)]

N. V. LUNINA and S. V. VOVK (Luganski Gosudarstvennyi Pedagogicheskii Institut, Lugansk, Ukraine) Fizioligicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 38, no. 3, May-June 1992, p. 43-49. In Ukrainian. refs

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A92-47309

EVIDENCE THAT EUKARYOTES AND ECOCYTE PROKARYOTES ARE IMMEDIATE RELATIVES

MARIA C. RIVERA and JAMES A. LAKE (California, University, Los Angeles) Science (ISSN 0036-8075), vol. 257, no. 5066, July 3, 1992, p. 74-76. Research supported by NSF, NIH, and Alfred P. Sloan Foundation. refs

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The phylogenetic origin of eukaryotes was unclear because eukaryotic nuclear genes have diverged substantially from prokaryotic ones. The genes coding for elongation factor EF-1-alpha were compared among various organisms. The EF-1-alpha sequences of eukaryotes contained an 11-amino-acid segment that was also found in eocytes (extremely thermophilic, sulfur-metabolizing bacteria) but that was absent in all other bacteria. The related (paralogous) genes encoding elongation factor EF-2 and initiation factor IF-2 also lacked the 11-amino-acid insert. These data imply that the eocytes are the closest surviving relatives (sister taxon) of the eukaryotes. Author

A92-48096

THE EFFECTS OF MICROGRAVITY ON THE CHARACTER OF THE PROGENY OF DROSOPHILA MELANOGASTER

DUANE M. RUMBAUGH, DAVID A. WASHBURN, WILLIAM D. HOPKINS, and E. S. SAVAGE-RUMBAUGH (Georgia State University, Atlanta) IN: Primatology Today. Amsterdam, Elsevier Science Publishers, 1991, p. 701, 702. (Contract NIH-RR-00165; NIH-HD-06016; NAG2-438)

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To study how the microgravitational environment influences the character of the progeny of Drosophila melanogaster, the S1 insects produced during the 8-days of space flight were self-bred for four generations. Higher variational rate was found in S2. After removing the variant flies, the variational rate of the remaining Drosophila progeny decreased generation by generation. There was no notable sex-linked recessive lethal mutation of parent flies and no gene mutation found in their test-cross examination. It
indicates that the germ-cell of parent adult flies were not much influenced by microgravity, but the embryo of filial generation bred in space were greatly influenced by microgravity. Therefore, the mutagenesis during the embryonic development should be taken into account in the bio-breeding under the space microgravitational environment.

Author

A92-2883#  THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE FAST ROTATING CLINOSTAT

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The paper investigates, both theoretically and experimentally, the validity of the fast rotating clinostat to simulate microgravity for a free-swimming single-cell organism such as the paramecium. Computer simulations show that cells on suspension move as cells cultivated in space. However, rotated paramecia are still affected by gravity, as shown by the variations in the rate of paramecium rotation on their axis. Using a fast clinostat, which allows to investigate simultaneously twenty cultures, a stimulating effect on cell growth rate was observed, similar to that previously reported in space.

Author

N92-2882#  EFFECTS OF EXTREMELY HIGH G ACCELERATION FORCES ON NASA'S CONTROL AND SPACE EXPOSED TOMATO SEEDS Special Publication
ROGER WENTLING and CARL DEFRANCO Dec. 1991 76 p (AD-A247486; ARAED-SP-91002) Avail: CASI HC A05/MF A01

An experiment to expose tomato seeds to high levels of mechanical shock after they had spent six years in space aboard NASA's Long Duration Exposure Facility was conducted in the High 'G' Air gun Test Facility at Picatinny Arsenal. A group of control seeds that did not go into space were also exposed to high levels of shock. The object of this test was to determine if high levels of gravity affected the growth of the plants grown from this seed or the seeds from these plants. The tomato seeds were exposed from 1,256 times gravity (g) to 119,380 times gravity. Germination occurred at every level of testing and seeds from these plants will be saved to grow plants next year. In general, seeds from the higher shock levels produced higher quality tomatoes, and some abnormalities in developing of green tomatoes were observed at intermediate levels. Genetic effects, if any, are expected to be observed in the next generation which will be grown next year.

GRA

N92-28382#  PRIMER ON MOLECULAR GENETICS
Apr. 1992 28 p Prepared in cooperation with DOE, Washington, DC (Contract DE-AC05-84OR-21400) (DE92-010680; ORNL/M-2026) Avail: CASI HC A03/MF A01

This report is taken from the April 1992 draft of the DOE Human Genome 1991-1992 Program Report, which is expected to be published in May 1992. The primer is intended to be an introduction to basic principles of molecular genetics pertaining to the genome project. The material contained herein is not final and may be incomplete. Techniques of genetic mapping and DNA sequencing are described.

DOE

N92-29089#  BIOLUMINESCENCE IN THE WESTERN ALBORAN SEA IN APRIL 1991 Final Report

This document reports on the results of an expedition to study bioluminescence in the western Alboran Sea of the Mediterranean in April 1991. Two oceanographic research vessels and a research submersible were involved in making extensive measurements of bioluminescence and optical properties, as well as related biological and physical parameters. The primary research tool used was the HIPLEX, a high resolution, state-of-the-art bathyphotometer. The results reported here cover only bioluminescence and related biological measurements made from the USNS Bartlett. Recommendations are given for survey requirements needed to extend measurements seasonally and geographically in this region of the Mediterranean.

GRA

N92-29397#  IN VITRO MEASUREMENT OF NUCLEUS PULPOSUS SWELLING PRESSURE: A NEW TECHNIQUE FOR STUDIES OF SPINAL ADAPTATION TO GRAVITY

Swellling of the intervertebral disc nucleus pulposus is altered by posture and gravity. We have designed and tested a new osmometer for in vitro determination of nucleus pulposus swelling pressure. The functional principle of the osmometer involves compressing a sample of nucleus pulposus with nitrogen gas until saline pressure gradients across a 0.45 microns Millipore filter are eliminated. Swelling pressure of both pooled dog and pooled pig lumbar disc nucleus pulposus were measured on the new osmometer and compared to swelling pressures determined using the equilibrium dialysis technique. The osmometer measured swelling pressures comparable to those obtained by the dialysis technique. This osmometer provides a rapid, direct, and accurate measurement of swelling pressure of the nucleus pulposus.

Author


An experimental analysis of the effects of low-dose ionizing radiation on sensory and motor function was conducted in baboons. Animals were trained using a reaction time procedure to respond to near-threshold acoustic and visual stimuli, and quantitative assessments were made of radiation-induced changes in absolute auditory and visual thresholds and reaction times. Animals received multiple exposures at single fractionated dose levels of 1, 2, and 5 Gy. Single exposures at higher exposure levels of 10 and 15 Gy were also examined. 100-200 cGy exposures produced transient changes in reaction times. Transient increases in reaction times occurred following low-dose exposures, usually within 1-3 weeks following the exposure. These increases typically recovered to normal baseline levels within 2-3 weeks. 1000 and 1500 cGy exposures produced long-term hearing deficits which were not frequency-specific. The severe hearing loss was most likely due to a sensorineural deficit, since complete loss of function of the tympanic membrane or middle ear ossicles would be expected to produce a hearing loss about 50-55 dB. These higher radiation doses have had less of an effect on visual intensity thresholds, producing a 5-10 dB deficit in visual thresholds. No physical damage to the cornea, iris, lens, or retina was observed.
The reactions were studied in three different aqueous solutions, being water, mineral salt medium, and a suspension with nongrowing culture media are considered. A mathematical model is set up. The steady state in the batch system and in continuous culture is considered and the development of some practical tools is described. Mathematical methods to analyze microbial system descriptions and experimental data are given. The stoichiometric and kinetic parameters of the Acinetobacter system are studied.


The chemical reactions involving carbon dioxide in mineral culture media are considered. A mathematical model is set up. The reactions were studied in three different aqueous solutions, being water, mineral salt medium and a suspension with nongrowing bacterial cells. For each situation, three methods were compared for the determination of the bicarbonate concentration on the solution: equilibrium state total carbon analysis, dynamic monitoring of the rate of acid or alkali addition, and dynamic measurement of the carbon dioxide gas phase mole fraction. In a batch stirred tank reactor, the equilibrium constant agreed with the published value, and the three bicarbonate analysis methods gave the same results. A real alkaliphilic process, using Acinetobacter calcoaceticus in a continuous stirred tank reactor at steady state, gave results in accord with the literature. However, the results do not allow validation of the equation expressing the nonideality. The steady state in the batch system and in continuous culture is well described with the mathematical model. However, in the transient state some unexplained differences between simulation and measurement, are noted.


During growth in mixtures of acetate and aldose sugars, the growth yield of the bacterium Acinetobacter calcoaceticus was increased when aldonolactone hydrolysis occurred. The underlying mechanism was investigated by studying the relationship between cellular yield and lactone hydrolysis in a quantitative way. The literature on the kinetics of acid formation from aldonolactones was reviewed. The reaction pattern is composed of lactone isomerization and hydrolysis steps which occur in series. In the acid pH range, lactone interconversion is the slowest step, whereas above pH 7 hydrolysis is rate limiting for acid formation. Only for D-glucuronolactone could a detailed mechanistic model be constructed. For a number of other aldonolactones including D-xylene and D-galactonolactone, an empirical kinetic equation was derived. The rate constants of these lactones are much smaller than for glucuronolactone. The kinetic model of the hydrolysis of xylolactone was tested, using the electrical charge balance in the Acinetobacter system. The published biomass yield data and the rate of lactone hydrolysis were compared. The observed relation seems to be only apparent. The electrical charge balance in the study of processes in which charged compounds are being converted is shown to be powerful.

Avail: CASI HC A03/MF A03

The occurrence and magnitude of the cell yield increase was studied over a broad range of specific growth rates. The effect was described with a mathematical model, where the energetics are covered by three basic parameters: the efficiency of oxidative phosphorylation, the yield of biomass in Adenosine Triphosphate (ATP), and the specific growth rate. The model further accounts for the reorganization of the macromolecular composition. This was described, leading to the formulation of the ATP balance. Experiments, using continuous cultures in steady state, are described. Macroscopic parameters and ATP coefficients are estimated for the Acinetobacter systems. The results are interpreted in physiological terms.

**N92-29739**
Technische Univ., Delft (Netherlands).
**FLUX-CAPACITY RELATIONSHIPS OF ACINETOBACTER CALCOACETICUS ENZYMES DURING XYLOSE OXIDATION**
Avail: CASI HC A03/MF A03

The regulation of acetate consumption, xylose oxidation via glucose dehydrogenase and Isocitrate Lyase (ICL) activity and NADPH dependent Isocitrate Dehydrogenase (ICDPH) activity on Acinetobacter is described as a function of the specific growth rate and the presence of xylose. The ability to oxidize xylose was constitutively present, but could be further induced by the supply of xylose. The maximum acetate conversion rate increased with increasing specific growth rates and was shown to be rate limiting at low dilution rates. The substrate flow through ICDPH and ICL increased at higher increasing specific growth rates, although only 20 percent of the capacity was used. Under some conditions, ICDPH activity was reduced by the supply of xylose to the culture. The results are discussed in relation to the cellular energy budget, and simple kinetic expressions are developed to describe the observations.

**N92-29740**
Technische Univ., Delft (Netherlands).
**ANALYSIS AND EXPERIMENTAL TESTING OF A BOTTLENECK MODEL FOR THE DESCRIPTION OF MICROBIAL DYNAMICS**
Avail: CASI HC A03/MF A03

Cellular control mechanisms play an important role in the productivity of large scale biotechnological processes. They can be studied in isolation in small scale reactors, by monitoring the microbial response after a deliberate disturbance of a steady state. Generally, a two phase response is observed, involving a rapid utilization of a metabolic overcapacity and a slow subsequent reorganization of the macromolecular composition. This was quantified in a mathematical bottleneck model, with a simple representation of enzyme activation and deactivation phenomena. Steady and transient states were described with the same model, where, for each substrate, the dynamic state allows the separate determination of the activation and deactivation parameters which are pumped on the steady state. This model was experimentally tested, using Acinetobacter calcoaceticus in continuous cultures, supplied with acetate and xylose. Transient states were obtained by a stepwise shift of the dilution rate and the xylose/acetate feed ratio. A strong dependency of the regulatory parameters of acetate and xylose conversion on the presence of xylose is reported.

**N92-29754**
Technische Univ., Delft (Netherlands).
**STATE ESTIMATION AND ERROR DIAGNOSIS FOR BIOTECHNOLOGICAL PROCESSES**
Ph.D. Thesis


A means of obtaining a more accurate and reliable characterization of the process state, without additional process information, and an improvement of the possibilities for process control are discussed. The currently available methods for state estimation are overviewed. The application of a state estimation within a process controller is described. An analytical approach is used to develop an insensitive state estimator. Systematic methods to check the consistency of the measurements are discussed.

**N92-29755**
Technische Univ., Delft (Netherlands).
**THE USE OF STATE ESTIMATORS (OBERVERS) FOR ON-LINE ESTIMATION OF NON-MEASURABLE PROCESS VARIABLES**
Avail: CASI HC A03/MF A02

An approach to the measurement of key variables in bioprocess control, which uses direct online measurements made in conjunction with a computational model of the process to obtain estimates for the values of less easily measurable variables, is considered. This information can be used to control the process. The combination of model and measurement is known as an observer. The measurements taken are used to correct the state estimates provided by the model. The art of using observers lies in the development of good models and the appropriate corrections. Several alternatives for the tuning of observers are presented. Attention is paid to the effect of model errors. Adaptive structures, used to correct the model, may be helpful in solving the bias caused in the estimates. Some recent developments are discussed.

**N92-29756**
Technische Univ., Delft (Netherlands).
**STATE ESTIMATION AND CONTROL OF THE IBE-FERMENTATION WITH PRODUCT RECOVERY**
Avail: CASI HC A03/MF A02

The control of the combined process for the continuous production of Isopropanol, Butanol, and Ethanol (IBE) from whey permeate is discussed. This process consists of a fluidized bed reactor coupled with a product recovery unit. Immobilized clostridia are used for this fermentation. The process combined a high biomass retention with relatively low product concentrations. The experimental setup is described. The mathematical model is presented and the state observer is examined. The two different control strategies are developed and the results of both control strategies are compared.

**N92-29757**
Technische Univ., Delft (Netherlands).
**A LOW SENSITIVITY OBSERVER FOR COMPLEX BIOTECHNOLOGICAL PROCESSES**
Avail: CASI HC A03/MF A02

Process monitoring and control are frequently hindered by a lack of on-line information. State estimators may be used to estimate the actual values of unmeasurable process variables. However, errors in the process model incorporated in the estimator can easily cause a bias in the estimated variables. Sometimes, these errors are successfully reduced by implementation of a parameter estimator. An alternative approach: the low sensitivity observer is presented. This estimator is so tuned as to minimize sensitivity to certain errors in the process model. A low sensitivity observer was developed for a relatively complex process with five
state variables, fourteen model parameters, and two online measurements. A numerical solution is presented. The problem of analyzing the large amount of simulation data was solved. An example of how such a low sensitivity observer can be made insensitive with respect to the given model errors is presented. This low sensitivity observer is used with experimental data to show that it is insensitive as required during the steady state. This result indicates that the theory of low sensitivity observers is more generally applicable than thought.


The influence of parameter errors in the process model used in an observer is described. In controlling a biotechnological process, the process variables of primary interest can often not be measured online. To estimate these primary control variables, an observer can be applied. However, errors may reduce the quality of the estimates. An observer insensitive to certain parameter errors in a process model was constructed. Such an observer is referred to as a low sensitivity observer. The conditions for low sensitivity were derived analytically. The general solution obtained was applied for any possible working point and parameter set. The applicability of the analytical solution was tested by using the low sensitivity observer in a feedback control loop. The process under consideration was a bench scale, continuous ethanol fermentation with product recovery. The nonmeasured substrate concentration was controlled by modifying the dilution rate. The substrate estimate obtained from this system remained correct irrespective of the occurrence of specific model errors. A gradual decrease of the dilution rate had no significant influence on the quality of the estimate. The analytical solution is shown to function well for control purposes.


Balancing techniques to systematically check measurement data for the presence of errors are described. A number of equality constraints are used. The development of a new method to obtain a set of equations for balancing the measured conversion rates is described. The procedure provides an equation to give estimates of the nonmeasured conversion rates, after the measurements are balanced. A new and efficient method to determine whether or not the conversion rates are balanceable and calculable is described. The method differs from the graph/theoretical method and is implemented into a computer program. The residuals of the redundancy relations are tested by means of a chi square test to decide whether there are significant errors in the data. A new and powerful method to locate the source of an error is presented. This method for error diagnosis is both powerful and numerically efficient. The methods described are illustrated by applying them to several sets of published data.


A method to test for the presence of relatively small systematic measurement errors (bias) is described. A balancing technique is used to check and improve the consistency of the measurements. The primary measurements are translated into observed conversions. The balancing technique was applied sequentially in time. By combining the result of the individual tests, the sensitivity of the method to measurement errors was improved. Accordingly, a rather sensitive statistical test for systematic errors was obtained. The means by which conversion terms can be obtained from primary measurements were analyzed. The expression of individual errors in the primary measurements within the vector of residuals was investigated. The error diagnostic method was adapted so as to test directly for errors in the primary measurements. A quantitative measure for error sensitivity was developed. The methods described are illustrated by applying them to data from an industrial process.

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.


Approximately 10 percent of pilots are alcoholics. The present survey of the current scientific understanding of the neurophysiological bases of alcohol addiction is presented in the autobiographical framework of the career experiences of a licensed pilot who is a recovering alcoholic. Basic research in brain chemistry is discussed in the context of clinical observations of alcoholic behavior.


A particularly insidious problem in airline safety is presented by the fact that psychoactive drugs (PADs), which encompass many prescription and nonprescription drugs as well as alcohol, nicotine, and illegally traded narcotics, affect not only pilot psychomotor-task abilities, but pilot judgment, as well. The capacity for assimilation of large amounts of information, as well as for swift, critical decisions, is significantly impaired. A comprehensive characterization is made of the effects of the various commonly encountered PADs.


A series of FAA-funded studies has led to the development of a PC-based battery of cognitive function tests for medical certification of individuals, designated 'COGSCREEN'. The sensitivity, specificity, and usability of COGSCREEN has been suggested by the ability of such testing to distinguish groups of
licensed pilots and nonpilot 'normal' subjects from a group of neuropsychological patients. COGSCREEN is currently being standardized on a population of healthy pilots.

O.C.

A92-45011
HEART RATE VARIABILITY AND AUDITORY WORKLOAD DURING NOISE STRESS: SPEAKER SEX AND BANDPASS EFFECTS ON SPEECH INTELLIGIBILITY

An effort has been made to experimentally evaluate the relative effectiveness of male and female voice-based warning systems under realistic cockpit conditions. It has been observed that under conditions of high noise stress, female speakers were less intelligible than males, and were associated with a higher mental workload than male voices. It is also noted that cardiovascular measures were sensitive to auditory workloads under test conditions.

O.C.

A92-45012
HEART RATE VARIABILITY AS AN INDEX FOR PILOT WORKLOAD

A key factor in prospective progress toward excessive pilot workload strategy development is the establishment of standardized methods for workload assessment and analysis, in conjunction with validated workload-prediction algorithms. Attention is presently given to one candidate for standardization, the spectral analysis of heart rate variability (HRV), in view of the results of a simulator study that compared the theoretical evaluation of flight-task difficulty with heart-rate variability. HRV is found to correlate consistently and meaningfully with variations in aviation workloads.

O.C.

A92-45014
EEG CORRELATES OF DECISION MAKING IN COMPUTER SIMULATED COMBAT
GINA R. POE, BRANDALL Y. SUYENOBU (USVA, Medical Center, Sepulveda, California, University, Los Angeles), CHERYL A. BOSTAD (Northrop Corp., Aircraft Div., Hawthorne, CA), MICA R. ENDLESBY (Texas Tech University, Lubbock), and MAURICE B. STERMAN (USVA, Medical Center, Sepulveda, California, University, Los Angeles) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 758-763. Research supported by Northrop Corp. and USVA. refs

Suppression of the dominant EEG frequency, defined as that frequency displaying the highest spectral density within an eyes-closed resting period, could be attributed to increased cortical processing of external information and might therefore be indicative of pilot overwork. An effort is presently made to confirm such findings in the context of a controlled flight simulation in which the performance of experienced pilots was quantified in a technically demanding context. As predicted, simulated combat engagements were indicated by decreased activation across the sensorimotor strip; there was a trend toward increased laterality, with greater activation along the right sensorimotor strip in positive-outcome interactions.

O.C.

A92-45015
TOPOGRAPHIC EEG CORRELATES OF PERCEPTUAL DEFENSIVENESS
MAURICE B. STERMAN (USVA, Medical Center, Sepulveda, CA) and MIRANDA OLFF (Utrecht, State University, Netherlands) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 764-769. refs

It has been theorized that psychological defense mechanisms disturb perception in highly threatening situations to an extent that compromises judgment and performance; this disturbance presumably arises from an aberrant cognitive response to the situation. An effort is presently made to evaluate this hypothesis through the study of corresponding EEG response patterns, using Kragh's (1960) Defense Mechanism Test (DMT). Subjects who scored highest on the DMT showed a significantly greater attenuation of 8-12 Hz activity at midcentral and parietal cortical sites with threat perception than those with low DMT scores. This overloading of neural resources for psychologically defensive purposes may leave less of them available for critical decisionmaking.

O.C.

A92-45016
SOME FACTORS ASSOCIATED WITH PILOT AGE IN GENERAL AVIATION CRASHES

A sample of 1034 NTSB Accident Brief reports for 1985/86 were analyzed to discern age differences of pilots in the characteristics of general aviation airplane accidents. Pilots aged 60 or more were more involved in taxiing accidents and those under 30 more in the maneuvering phase. In combination with pilot exposure data from another study and FAA accident data for 1986, the accident rates of pilots aged 60 or more and younger pilots were estimated. Those aged 60 or more had an accident rate about twice that of the younger pilots.

Author

A92-45020
THE UTILIZATION OF THE AVIATION SAFETY REPORTING SYSTEM - A CASE STUDY IN PILOT FATIGUE

The extent to which the optimal safety and efficiency of airline operations are affected by whether their aircrews are well rested and alert is presently evaluated in light of data from the Aviation Safety Reporting System's questionnaires. Attention is drawn to the apparently counterintuitive finding that the majority of reported accidents occurred within the first two hours of the pilots' scheduled flying time. More specialized and intensive research on this factor is called for.

O.C.

A92-45021
VIGILANCE OF AIRCRAFTS DURING LONG-HAUL FLIGHTS

An effort is made to identify the factors that can modify pilot vigilance and performance during long-haul flights, in order to either institute measures for the reinvigoration of pilots or propose rest and nap periods. A data base encompassing such quantitative physiological data as pilot EEGs, EOGs, and EKGs were used to compile a database for further analysis. Vigilance was assessed by the increase in the slow bands of EEG and in blink frequency, shows important variations during the low workload/monotonous activity cruising phase of a long-range flight.

O.C.

A92-45029
VARIABLES AFFECTING SIMULATOR SICKNESS - REPORT OF A SEMI-AUTOMATIC SCORING SYSTEM

333
The results demonstrated that the blood levels of histamine increased significantly following MS and were even higher in the subjects using the TTS-S, but no significant changes were found in the blood levels of 5-HT following MS nor any effect on TTS-S on it. The results suggest that histamine contributes to the development of MS, and scopolamine may exert its anti-MS action by affecting the histaminergic system as well as the acetylcholinergic system; there may not be a definite relation between 5-HT and the development of MS.

Author

A92-45818

USE OF A MOTION SICKNESS HISTORY QUESTIONNAIRE FOR PREDICTION OF SIMULATOR SICKNESS

ROBERT S. KENNEDY (Essex Corp., Orlando, FL), JENNIFER E. FOWLKES (Enzian Technology, Inc., Orlando, FL), KEVIN S. BE-BAUM (Iowa, University, Iowa City), and MICHAEL G. LILIENTHAL (U.S. Navy, Naval Air Systems Command, Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 7, July 1992, p. 588-593. refs

Copyright

This research assessed the usefulness of the Motion History Questionnaire (MHQ) for the prediction of simulator sickness, a form of motion sickness experienced by pilots training in ground-based flight simulators. Four MHQ scoring keys were compared: (1) the original MHQ key which had been validated on a sample of U.S. Navy student pilots exposed to Coriolis forces, (2) and (3) two keys which had been validated on a sample of civilian college students exposed to simulated ship motions, and (4) a simulator sickness key empirically derived in the present research and cross-validated. Navy and Marine Corps aviators (N = 456) filled out the MHQ prior to their regularly scheduled flight simulator training and were divided into validation and cross-validation samples. All scoring keys were predictive of reported symptoms of sickness, but highest correlations were obtained with the empirically derived simulator sickness (SS) key. It is suggested that the SS key be used for self-testing so that pilots may be made aware of their risk for developing simulator sickness.

Author

A92-45819

SUSTAINED ATTENTION AND SERIAL RESPONDING IN HEAT - MENTAL EFFORT IN THE CONTROL OF PERFORMANCE


Copyright

The effects of heat (40 C) on sustained attention and serial responding were studied in a simple reaction time task and a serial four-choice reaction time task, respectively. Core temperature (Tc), heart rate variability (HV), and subjective reactions were monitored during the 80 min of exposure time. Simple reaction time performance and accuracy in the serial choice reaction time task deteriorated significantly in heat. In the serial choice reaction time task, the effects of heat on response times and on HV were correlated. Performance and level of Tc were not correlated, but a relationship was found between performance and the rate of Tc change. Results are discussed in relation to the thermophysiological status of the subjects and the compensatory mechanism of effort allocation. It is proposed that task characteristics regulate the degree of activity of this compensatory mechanism.

Author
The underlying etiology, the diagnosis, and management of IEBT wounds. Medical lasers used in these environments can provide additional benefits in aviation and space environments, including rapid control of bleeding wounds, reduce aircraft environmental contamination from body fluids and secretions, and faster rapid wound care techniques for trauma in the aviation and space environments.

A92-45821  
INNER EAR BAROTRAUMA - A CASE FOR EXPLORATORY TYPANOTOMY  
DENNA H. ASHTON AND LAURANCE A. WATSON (Royal Australian Air Force, Directorate of Health Services, Canberra, Australia) Aviation, Space, and Environmental Medicine (ISSN 0095-6652), vol. 63, no. 7, July 1992, p. 612-615. refs  
Copyright  
A case of inner ear barotrauma (IEBT) due to an hypobaric chamber experience is presented. IEBT is an exceedingly rare condition in aviation. In the case described, the diagnosis was initially unsuspected due to accompanying middle ear barotrauma. The underlying etiology, the diagnosis, and management of IEBT are discussed.  
Author

A92-45822  
MENSTRUAL HISTORY IN ALTITUDE CHAMBER TRAINEES  
JENNIFER U. SCHIRMER AND WILBUR T. WORKMAN (USAF, Armstrong Laboratory, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6652), vol. 63, no. 7, July 1992, p. 616-618. refs  
Copyright  
Menstrual history in women completing altitude chamber training is analyzed. After completing altitude chamber flights, data on age, day of menstrual cycle, birth control pill (BCP) use, and mean durations of menstrual cycle and menses were collected. No differences were found between mean duration of menstrual cycle and menses in the Yes and No BCP groups. Women completing altitude chamber training without developing altitude-induced decompression sickness (DCS) appear to be evenly distributed across their menstrual cycle, with the use of BCPs not affecting their susceptibility to DCS.  
P.D.

A92-45823  
LASER SURGERY PROCEDURES IN THE OPERATIONAL KC-135E AVIATION ENVIRONMENT  
MICHAEL COLVARD (USAF, Strategic Air Command Clinic, Chicago, IL), PAUL KUO (Loyola University, Maywood, IL), RICHARD CALEEL (Chicago College of Osteopathic Medicine, Downers Grove, IL), JACK LABO (USAF, Armstrong Laboratory, Brooks AFB, TX), and ROBERT SELF (National Guard Bureau, Andrews AFB, MD) Aviation, Space, and Environmental Medicine (ISSN 0095-6652), vol. 63, no. 7, July 1992, p. 619-623. refs  
Copyright  
The operational aviation and space environments present a potential for surgical trauma to aircrew and passengers. Current wound care techniques for trauma in the aviation and space medicine environment focus on classical surgical management of wounds. Medical lasers used in these environments can provide rapid control of bleeding wounds, reduce aircraft environmental contamination from body fluids and secretions, and faster rapid triage of injured personnel. Self-contained and reusable medical lasers have the potential to reduce the material supply of medical kits in the aviation and space environment. A miniaturized carbon dioxide laser was used to establish protocols and procedures for use on operational military KC-135E aircraft. Laser surgery was performed to demonstrate laser efficacy and safety in flight.  
Author

A92-45946  
CHANGES OF SERUM CORTISOL, INSULIN, GLUCAGON, THYROXINES AND CYCLIC NUCLEOTIDES PRE- AND POST-FLIGHT IN PILOTS  
CHANG-TAI XU, YU-MIN WANG (Air Force Hospital, Lanzhou, People's Republic of China) and BO-RONG PAN (Fourth Military Medical University, Xian, People's Republic of China) Space Medicine & Medical Engineering (ISSN 1002-0837), vol. 5, no. 1, 1992, p. 1-5. refs  
The effect of flight on the levels of blood-serum hormones in humans was investigated by measuring serum levels of cortisol, insulin, glucagon, thyroxines (T3 and T4), and cyclic nucleotides (cAMP and cGMP) in sera of ground crew members before and after a working day and of fighter pilots before and after a flight. Results of radioimmunoassays showed that pilots who completed 0.5 to 3.5 hr flights on a J-6 fighter, at air speeds from 400 to 800 km/hr, exhibited significantly lower levels of cAMP and cGMP and higher levels of insulin than they did before flights, whereas the levels of T3, T4, and cGMP did not change. The groundcrew members showed only slight decreases of insulin as a result of maintenance work.  
I.S.

A92-45947  
ANALYSIS OF THE MECHANISM AND PROTECTION OF UPPER LIMB WINDBLAST FLAILING INJURY  
The mechanism of the upper limb windblast flailing injury of pilots during ejection was investigated analytically. The constraining equations for steady states were developed and were used to calculate the value of constraining force needed for the protection of the upper limb at steady-state ejection. Calculations of the lowest constraining forces needed for the upper limb, under the configuration of hands on the top of the thighs and hands on alternate firing handle showed that the optimal location to exert minimal constraining forces on upper limbs is close to the elbow joints and the carpus joints. The design of an arm-restraint plate and the optimum ejection attitude are discussed.  
I.S.

A92-45950  
COLD AND HYPOXIA  
CHENG PANG (Institute of Space Medico-Engineering, Beijing, People's Republic of China) Space Medicine & Medical Engineering (ISSN 1002-0837), vol. 5, no. 1, 1992, p. 61-66. In Chinese. refs  
The combined effects of cold and hypoxia on the thermoregulation, tolerance to hypoxia, and water exchange parameters were examined. It is pointed out that hypoxia may reduce the capacity of thermoregulation and to cause difficulties in maintaining the work capacity of workers in cold environment. On the other hand, cold can decrease the limit of tolerance to hypoxia and speed up the development of hypoxia symptoms at high altitudes. It was also found that the exposures to cold and hypoxia can cause dehydration, although their effects on water exchange may not be additive.  
I.S.

A92-48297  
THE EFFECT OF ACCOMMODATION ON RETINAL IMAGE SIZE  
GEORGE SMITH (Melbourne, University, Parkville, Australia), JAMES W. MEEHAN (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France), and ROSS H. DAY (Monash University, Clayton, Australia) Human Factors (ISSN 0018-7208), vol. 34, no. 3, June 1992, p. 289-301. refs  
Copyright
Using schematic eyes, the change in retinal image size caused by a change in accommodation micropsia is investigated. The use of schematic eyes is also discussed and is justified. The calculated magnitude of this diminution for four schematic eyes ranged from unity at infinity to a maximum of 0.98 (-2 percent) at about 12.0 diopters (D). For distances at which accommodation micropsia is typically observed (about 2.0 D), retinal minification is less than 0.997 (-0.3 percent). Thus changes in the size of the retinal image attributable to accommodation are virtually negligible when compared with the observed reduction of 3 percent to 33 percent. This suggests that accommodation micropsia is mediated almost entirely by processes other than those involving the optics of the eye.

Author: P. L. SLEPENKOV

THE ANTHROPOMETRIC SURVEY FOR JASDF MEN AND WOMEN - 1988. I - METHODS AND STATISTICS OF BODY DIMENSIONS

YUKIKO KAKIMOTO, ATSUSHI KADDO, SHUJI NISHI, ZOJIRO KATOH, KIYOSHI MIZUMOTO, YOSHINORI TAKEUCHI, and YUKO NAGASAWA


RESULTS ON ANTI-G STRAINING MANEUVERS (AGSM) PHYSIOLOGY

EARL H. WOOD (Mayo Medical Center, Rochester, MN)


PARD

A92-28277# California Univ., Berkeley. Lawrence Berkeley Lab.

PROBLEMS IN MECHANISTIC THEORETICAL MODELS FOR CELL TRANSFORMATION BY IONIZING RADIATION

A. CHATTERJEE and W. R. HOLLEY


Contract DE-AC03-76SF-00098

A mechanistic model based on yields of double strand breaks has been developed to determine the dose response curves for cell transformation frequencies. At its present stage the model is applicable to immortal cell lines and to various qualities (x-rays, neon and iron) of ionizing radiation. Presently, we have considered four types of processes which can lead to activation phenomena: (1) point mutation events on a regulatory segment of selected oncogenes; (2) inactivation of suppressor genes, through point mutation; (3) deletion of a suppressor gene by a single track; and (4) deletion of a suppressor gene by two tracks.

DOE

A92-28288# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA

EFFECTS OF HIGH TERRESTRIAL ALTITUDE ON MILITARY PERFORMANCE

LOUIS E. BANDERET and RICHARD L. BURSE

1991 31 p Submitted for publication

(AD-A246695; USARIEM-T2-92) Avail: CASI HC A03/MF A01

When people travel to terrestrial altitudes greater than 3000 m, their well being is usually compromised. At high altitude, the decreased atmospheric pressure results in a reduction of the partial pressure of oxygen and lowers the rate at which oxygen can diffuse into the blood. This decreases the oxygen supply to the brain, muscles, and other parts of the body and reduces the maximum rate at which the body can use oxygen to perform physical work. The main medical programs at high altitude which impact physical and mental performance are acute mountain sickness, high altitude cerebral edema (HACE), and high-altitude pulmonary edema. These disorders can usually be prevented by

I.S.

DANLEY 14 Feb. 1992 32 p

A92-47500

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A92-49299
ascending slowly to 3000 m and then climbing 500 m on each subsequent ascent, allowing 1-2 days to acclimatize at each altitude. High altitude exposure can have profound effects on mental processes. Judgment may be severely impaired, especially if an individual is exposed to an extremely high altitude or has signs of HACE. Typically, the rate of performance on many tasks slows. On others, people more frequently neglect conceptual, computational, and procedural strategies. The use of optimal ascent profiles, medications, psychological strategies, and nutrients can facilitate coping and functioning in high-altitude environments.

GRA

N92-28397# Arizona Univ., Tucson.


(Contract AF-AFOSR-0352-86) (AD-A247159; AFSOR-82-0146TR-PHASE-1) Avail: CASI HC A05/MF A01

The CNS Project combines several noninvasive methods for monitoring brain structure and function in a test battery. Phase One (1988-1991) focused on neuroanatomical and neurophysiological correlates of behavioral ear advantages for two sets of complex sounds. Fifteen subjects neurologically normal according to conventional standards were tested with dichotic listening (2 measures), NM (2 measures), evoked potentials (2 measures), and qEEG (4 measures). One subject was also tested under similar conditions with PET. Results indicated: (1) Each individual had a distinct sidedness bias articulated in terms of a combination of anatomical and physiological variables; (2) These individual patterns cut across conventional categories such as gender and handedness; (3) In some of the subjects, these CNS profiles comprised internally consistent patterns of asymmetries linking subcortical physiological, cortical anatomy and cortical physiology; (4) In others, departures from such consistency signaled evidence of a variety of subtle neuropathologies, such as stuttering, mild learning disorder, central auditory dysfunction, or a history of hyperactivity and/or substance abuse.

GRA

N92-28420# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THERMOREGULATION DURING SPACEFLIGHT JOHN E. GREENLEAF and SUZANNE M. FORTNEY (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) Jan. 1992 34 p

(Contract RTOP 199-18-12-07) (NASA TM-103913; A-92043; NAS 1.15:103913) Avail: CASI HC A03/MF A01

The purpose of this flight proposal is to investigate human thermoregulatory parameters during exercise in microgravity. The hypothesis to be tested is that microgravity-adopted astronauts will exhibit accentuated increases in their core temperature (excess thermoregulatory parameters during exercise in microgravity in the human). The Center, Houston, TX.) Jan. 1992 34 p

THERMOREGULATION DURING SPACEFLIGHT

GRA

N92-28534# Netherlands Aerospace Medical Centre, Soesterberg.


Copyright Avail: CASI HC A02/MF A03

Flights of modern fighter aircraft are endangered by high G-forces, loss of situational awareness, and spatial disorientation. In order to prepare aircrew for these factors, ground based training facilities simulating some aspects of the relevant phenomena are used. The human centrifuge has proven to be rather effective in increasing G-tolerance, especially in conditions of high onset rate. Unrealistic simulations caused by the small radius of rotation in centrifuges can generate disturbing vestibular stimulation. During the development of the human centrifuge at the Netherlands Aerospace Medical Center an investigation was undertaken to find methods to suppress these detrimental effects. Smoothing of centrifuge motion and a realistic, computer-generated outside-vision system proved to be effective measures. Realistic target tracking and a cockpit-like environment are factors which enhance transfer of training.

N92-28655# Lawrence Livermore National Lab., CA.


(Contract W-7405-ENG-48) (DE92-009459; UCRL-JC-109513; CONF-9104298-2) Avail: CASI HC A02/MF A01

This report discusses the measurement of somatic gene-mutation frequencies in the human. Questions were asked concerning their measurement, response to radiation, ability to function as a dosimeter, and what they tell us about the somatic mutation theory of carcinogenesis.

DOE

N92-28755# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.


Avail: US Patent and Trademark Office

A portable diagnostic image analysis instrument is disclosed
for retinal funduscopy in which an eye fundus image is optically processed by a lens system to a charge coupled device (CCD) which produces recordable and viewable output data and is simultaneously viewable on an electronic view finder. The fundus image is processed to develop a representation of the vessel or vessels from the output data.

Official Gazette of the U.S. Patent and Trademark Office


A model for studying the blood flow in a flexible blood vessel is proposed. From the symptotic analysis of the flow equations, a one dimensional simplified equation is obtained. In this simplified equation, the flow mean velocity, the blood vessel cross section, and the blood vessel wall mean shear stress are considered. A numerical solution is calculated, by means of a finite volume method, which includes a flow decomposition technique. The results show that the rate of the acceleration of the voluminal force induced by the motion of the aircraft is one of the most important parameters concerning the pilot's loss of consciousness. ESA


We have completed the assessment of the diurnal variation in serotonergic activity in the SCN and its temporal relationship to wheel-running behavior under lightentrained (LD 14:10) and free-running (DD) conditions. First, under LD there was a marked diurnal rhythm in serotonergic activity with peak levels occurring at lightoff during the animals' initial bout of wheel-running activity. Thereafter, serotonergic activity decreased to daytime levels by the next morning, despite robust bouts of nocturnal wheel running behavior. Also, daytime periods of activity exhibited by some individuals was not associated with increased serotonergic activity. From these results, it is hypothesized that serotonin in the SCN does not acutely trigger motor activity. Instead, it appears that serotonin is involved in coordinating light-entrained activity rhythms with the LD cycle, which is consistent with the findings of other researches using lesions or pharmacological approaches. Our second original finding is that the diurnal rhythm is serotonergic activity that is lost, or greatly diminished, in free-running hamsters held under DD for 3 wks. Thus, the rhythm in serotonergic activity seen under LD probably is not circadian in nature, but is passively driven by an external influence, i.e., the light-dark cycle. GRA


Laser-induced, photooxidative damage in ocular tissue was studied with a quantitative assay using high performance liquid chromatography (HPLC) to separate oxidized and reduced ascorbic acid in exposed tissue components. We demonstrated that ascorbic acid, incubated with whole, bovine retinal pigment epithelial (RPE) cells, was oxidized when the reaction mixture was exposed to the output of an argon-ion continuous wave laser. The amount of ascorbic acid oxidized was proportional to the irradiance of the sample, and the reaction was wavelength-dependent, with short-wavelength visible light more effective than long-wavelengths in driving the reaction. The photosensitizing activity was associated with the RPE melamin pigment granules, and was not lost after disrupting or healing the RPE cells. Because melamin was known to form free radicals when illuminated, we hypothesized that ascorbic acid detoxified the light-activated melamin free radicals while being itself oxidized in process. If the supply of reduced ascorbic acid were exhausted, however, the activated melamin could have been the source of tissue-damaging radicals. This model was consistent with a photochemical damage mechanism involving light-activated melamin. GRA


This research has resulted in four separate projects. The first was the exposure of Fischer 344 rats to JP-8 jet fuel for 7 or 28 days. This exposure resulted in changes in pulmonary function and lung chemical mediators, specifically Substance P, after 28 days of exposure. The second project dealt with blocking the increase in SP in these rats by a pretreatment regimen with capsaicin before jet fuel exposure. Capsaicin caused a further increase in lung permeability and a million-fold increase in airway sensitivity to histamine after the 7-day jet fuel exposure. The third project dealt with the effects of a 7-day jet fuel exposure in congenic mice who are deficient in the inducibibility of the any hydrocarbon hydrolase enzyme. These mice are relatively resistant to the effects of jet fuel-induced lung injury. The fourth project investigated the effects of the jet fuel exposure on secondary organs, specifically the liver, spleen, and kidneys. There were pathological differences in the liver, spleen, and kidneys between the 7-day jet fuel exposure group and baseline controls. However, some of these differences were not apparent in the 28-day exposure group, possibly indicating compensatory mechanisms to the exposure. GRA


Quantitative procedures were developed for testing-block-structured models for multi-input nonlinear visual circuits studied with spatial-temporal white noise. A linear-nonlinear (LN) model test index was found to be suitable for classifying cells as simple versus complex. Although simple cells were better modeled as LN systems than complex cells, most simple cells deviated considerably from LN behavior. A nonlinearity of cortical origin would appear to be responsible, possibly activated more strongly by broadband noise than by sinewave grating stimuli. Also, two classes of binocular complex cells were identified. Whereas all binocular complex cells necessarily have a non-zero second-order interaction kernel, their second-order cross-eye interaction kernel could, it was found, be either non-zero or identically zero. GRA


A 10-year cumulative bibliography of publications resulting from
were collected on 1,292 male and female, active-duty Navy personnel in 1988 and 1989 as part of an on-going evaluation of the Navy's Health and Physical Readiness Program. Pearson's product-moment correlations revealed that EX was significantly, positively related to changes in SE and QOL over a one-year period, across the entire Navy sample. Tests which assessed the electromagnetic interference/compatibility and human factors. The tests were conducted using military and industrial standards and procedures for electromagnetic interference/compatibility and human factors. The LIFEPAK 8 was found to be compatible with U.S. Army medical evacuation UH-60A Blackhawk.

A review is presented of a workshop concerning: an understanding of the factors which contribute to aircrew error accidents and incidents, the methodology being employed to investigate such events, and prevention measures currently available to decrease the probability of mishaps. It is shown how these activities are closely interrelated in today's aviation. This workshop examined training procedures used in accident prevention as well as case studies of major aircraft accidents.

A review is presented of the evolutionary development of cockpit resource management and the continuing search for clear definition of the various programs conducted by different carriers. Attention is given to the development of an effective CRM program that includes key attributes such as situational awareness, assertiveness, communication, fatigue and stress. Consideration is given to scenario topics including weather, windshear, mental preparation, incapacitation etc.
A92-44907* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.  
THE ROLE OF BEHAVIORAL DECISION THEORY FOR COCKPIT INFORMATION MANAGEMENT  
(Contract NAS1-18028)  
The focus of this report is the consideration of one form of cognition - judgment and decision making, while examining some information management issues associated with the implementation of new forms of automation. As technology matures and more tasks become suitable to automation, human factors researchers will have to consider the effect that increasing automation will have on operator performance. Current technology allows flight deck designers the opportunity to automate activities involving substantially more cognitive processing.  
R.E.P.  

A92-44911  
HUMAN PERFORMANCE IN COMPLEX TASK ENVIRONMENTS - A BASIS FOR THE APPLICATION OF ADAPTIVE AUTOMATION  
There are a number of human performance issues that are highlighted by the application of adaptive automation technology to complex task environments. Few of these issues have received empirical human performance research. This paper describes those issues that have arisen with the Naval Air Development Center's Adaptive Function Allocation for Intelligent Cockpits (AFAIC) program.  
Author  

A92-44912* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.  
EFFECTS OF SHIFTS IN THE LEVEL OF AUTOMATION ON OPERATOR PERFORMANCE  
The results of two experiments examining the effects of shifts in the type and level of automation on operator performance are presented. The first experiment examines the costs and benefits of adaptive-automation shifts on operator performance, while the second experiment examines the effects of variations in automation reliability on operator detection of automation failures. Performance consequences of complacency in system monitoring are shown to be related to characteristics of the monitoring task automation, i.e., automation reliability and consistency.  
R.E.P.  

A92-44916*  
WHEN HIGH IS BIG AND LOW IS SMALL, DECISIONS AREN'T THAT HARD AT ALL - ANALOG ENCODING OF ALTITUDE IN C.D.T.I. REVISITED  
 Analogue and digital encoding of altitude in plan-view traffic situation displays was examined using nonpilots and pilots. The nonpilots were exposed to conditions from a 2 x 2 x 2 factorial design to assess the impact of altitude representation (analogue/digital), altitude reference point (absolute/relative), and altitude prediction (present/absent). Pilots were exposed to conditions from a 2 x 2 within-subjects factorial design derived from the nonpilot design by deleting prediction as a factor (always present). Subjects examined traffic situations as presented through the display and responded with maneuvers they deemed necessary to maintain horizontal and vertical separation from other aircraft. Dependent variables were response time and correctness/ of maneuver. Overall response times were governed by an interaction between reference point and predictor presence with significant main effects and a significant interaction, but analogue/digital format was not a significant factor. Accuracy results were not straightforward. Preliminary results for the small pilot sample indicated slightly shorter response times and slightly higher accuracy rates using analogue representations and a qualified preference for the analogue-relative display.  
Author  

A92-44917* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.  
TRAINING AND COCKPIT DESIGN TO PROMOTE EXPERT PERFORMANCE  
The behavior of expert pilots in familiar situations is explored and the implications for better training programs and cockpit designs are stated. Experts in familiar operational situations performing highly practiced tasks are said to recognize and respond to complex situations using pattern recognition or intuition. For some tasks this class of behaviors is desirable; performance can be improved by reducing cognitive load and increasing speed and accuracy. Part-task training, training for monitoring and techniques for the transfer of knowledge can facilitate the development of these skills. Methods for promoting pattern recognition through pilot-aircraft interface design include the use of spatial presentations of information and providing triggering events. In some instances, well practiced behavior is not appropriate and it is desirable to prevent the response. When prevention is necessary, barriers can be constructed in the interface to remind the pilot of the inappropriateness of the response.  
Author  

A92-44921  
THE EMERGENCY CHECKLIST, TESTING VARIOUS LAYOUTS  
Based on recommendations from a previous study two new versions were made of the Airbus A-310 emergency checklist (ECL). These were compared to the current checklist in an experimental setup. Pilots were asked to search and read three emergency procedures in one of the three versions of the checklist. Search and reading time and number of errors were recorded. Subjects were asked to judge various aspects of the checklists on a five-point scale. The number of errors was too small to use in the analysis, confirming the hypothesis that the strategy of pilots is to maximize accuracy. Search and reading time showed only small differences between the three versions, but subjective judgments were in favor of the new version of the checklist. These results may be explained by the possibility to create truly realistic emergency situations, whereas pilots do have a clear idea of such situations.  
Author  

A92-44925  
PILOT ATTITUDES TO COCKPIT AUTOMATION  
A study has been conducted to assess the opinions and attitudes of UK commercial pilots to advanced automated aircraft. General findings indicated that flying skills are not reduced by automation and that there is an over-reliance on automation. Nevertheless, it is felt that automation on flight decks
is advantageous as it reduces crew fatigue, and the majority of pilots enjoy flying automated aircraft. R.E.P.

A92-44930* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE EFFECTS OF SPEECH CONTROLS ON PERFORMANCE IN ADVANCED HELICOPTERS IN A DOUBLE SIMULATION PARADIGM


The potential benefit of speech as a control modality has been investigated with mixed results. Earlier studies suggest that speech controls can reduce the potential of manual control overloads and improve time-sharing performance. However, these benefits were not without costs. Pilots reported higher workload levels associated with the use of speech controls. To further investigate these previous findings, an experiment was conducted in a simulation of an advanced single-pilot, scout/attack helicopter at NASA-Ames' ICAB (interchangeable cab) facility. Objective performance data indicated that speech control modality increased workload, subjective ratings, however, indicated that the speech control modality increased workload. Post-flight debriefing indicated that the results were mainly due to the increased effort to speak precisely to a less than perfect voice recognition system. Author

A92-44933* THE FLIGHT MANAGEMENT SYSTEM - 'RUMORS AND FACTS'


While communication and captain personality type have been separately shown to relate to overall crew performance, this study attempts to establish a link between communication and personality among 12 crews whose captains represent three pre-selected personality profiles (EE+, EE, Ec). Results from analyzing transcribed speech from one leg of a full-mission simulation study, so far indicate several discriminating patterns involving ratios of total initiating speech (captain to crew members); in particular commands, questions and observations. Author

A92-44934* COMMUNICATION VARIATIONS RELATED TO LEADER PERSONALITY


While communication and captain personality type have been separately shown to relate to overall crew performance, this study attempts to establish a link between communication and personality among 12 crews whose captains represent three pre-selected personality profiles (EE+, EE, Ec). Results from analyzing transcribed speech from one leg of a full-mission simulation study, so far indicate several discriminating patterns involving ratios of total initiating speech (captain to crew members); in particular commands, questions and observations. Author

A92-44935* COORDINATION STRATEGIES OF CREW MANAGEMENT


An exploratory study that describes and contrasts two three-person flight crews performing in a B-727 simulator is presented. This study specifically attempts to delineate crew communication patterns accounting for measured differences in performance across routine and nonroutine flight patterns. The communication patterns in the two crews evaluated indicated different modes of coordination, i.e., standardization in the less effective crew and planning/mutual adjustment in the more effective crew. R.E.P.

A92-44936* INFORMATION TRANSFER AND SHARED MENTAL MODELS FOR DECISION MAKING


A study to determine how communication influences flight crew performance is presented. This analysis focuses on the content of communication, principally asking what an utterance does from a cognitive, problem solving viewpoint. Two questions are addressed in this study: how is language utilized to manage problems in the cockpit, and are there differences between two- and three-member crews in their communication and problem solving strategies? R.E.P.

A92-44937* COLLABORATION IN PILOT-CONTROLLER COMMUNICATION


A field study of pilot-controller communication that is expected to improve communication accuracy and efficiency in at least two ways is presented. Types of problems that disrupt routine communication and how often they occur during operations are identified. By identifying factors associated with problems, it is suggested why they occur and how to eliminate them. R.E.P.

A92-44939 AIRCREW COORDINATION FOR ARMY HELICOPTERS - RESEARCH OVERVIEW


An overview is presented of an on-going research project of the U.S. Army to provide their aviation community with improved
procedures and techniques for training and evaluating aircrew coordination skills in rotary wing aviators. This research responds to that portion of the human error problem represented by inadequate coordination of crew decisions and actions in the cockpit. It is shown that training for the complex aviation weapon systems must increasingly address total system performance, with particular emphasis on the demanding environments unique to the Army aviator.

R.E.P.

A92-44940
AIRCREW COORDINATION FOR ARMY HELICOPTERS - AN EXPLORATION OF THE ATTITUDE-BEHAVIOR-PERFORMANCE RELATIONSHIP

The relationships between aircrew coordination attitudes, behavior, and mission performance were examined using data obtained from a flight-simulator facility. The behavior-performance link, previously established by Povemire et al. (1989), was confirmed with aircrew coordination-related behavioral ratings accounting for approximately 50 percent of the variance in performance. An attitude measure was factor-analyzed, and the factors obtained were similar to those identified in the Gregorich et al. (1990) study. Various weight combinations of crew-attitude scores were investigated with a coefficient of agreement (absolute difference score) determined as best explaining the variance in the behavior and mission performance measures. Attitude and behavior measures combined to account for approximately 65 percent of the variance in mission performance.

Author

A92-44941
TRAINING IMPLICATIONS OF A TEAM DECISION MODEL

A team decision model was used to design training for crew coordination in the tactical helicopter domain. Ten aircrews are studied while conducting a tactical mission in a UH-60 Blackhawk simulator facility. Several opportunities for training were identified: (1) improving commander's intent and mental rehearsal of functional mission segments during premission planning; (2) improving recognition of time horizons; (3) improving resource allocation and performance monitoring; and (4) improving anticipation of information needs.

Author

A92-44942
INSTRUCTIONAL STRATEGY FOR AIRCREW COORDINATION TRAINING

A review is presented of research conducted by the Naval Training Systems Center (NTSC) on training strategies designed to enhance coordination and management in the cockpit that can be applied to provide skill-based training for feedback to Aircrews. This work has led NTSC to develop an Aircrew Coordination Training program that specifically provides crew coordination training that is skill-based, behavioral, mission specific, and capable of integration into existing training programs. NTSC's skill-based training approach is shown to be behavioral, designed to change performances, rather than attitudes or knowledge of trainees.

R.E.P.

A92-44943
THE ASSESSMENT OF COORDINATION DEMAND FOR HELICOPTER FLIGHT REQUIREMENTS
CLINT A. BOWERS, BEN B. MORGAN, JR. (Central Florida University, Orlando, FL), and EDUARDO SALAS (U.S. Navy, Naval Training Systems Center, Orlando, FL) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1, Columbus, OH, Ohio State University, 1991, p. 308-313. refs

An overview is presented of a military aircrew coordination training program that focuses on the training of the specific skills and behaviors that comprise aircrew coordination. For this program, a questionnaire was prepared to measure pilots' perceptions of the coordination demand imposed by a sample of CH-46 flight tasks. In addition to rating the coordination demand associated with each coordination skill dimension, pilots were requested to provide their perceptions of the amount of overall workload and total coordination demand imposed by each task.

R.E.P.

A92-44944
DEVELOPMENT OF AIRCREW COORDINATION EXERCISES TO FACILITATE TRAINING TRANSFER
DAVID P. BAKER (U.S. Navy, Naval Training Systems Center, Orlando, FL), MITCH BAUMAN (U.S. Marine Corps, Washington, DC), and MARY D. ZALESNY (Kent State University, OH) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1, Columbus, OH, Ohio State University, 1991, p. 314-319. refs

This paper describes and reports the trainee reactions to two new exercises that have been pilot tested in an Aircrew Coordination Training (ACT) program. The exercises were developed to allow for the active practice of aircrew coordination skills. Both quantitative and qualitative reactions to the exercises were collected. These data indicated positive reactions by the trainees. In addition a review of the qualitative responses suggested that trainees who participated in these exercises could cite specific ways in which they planned to use this information during subsequent missions as opposed to pilots who had not participated in these exercises during training.

Author

A92-44945
AIRCREW COORDINATION FOR ARMY HELICOPTERS - IMPROVED PROCEDURES FOR ACCIDENT INVESTIGATION

Army accident investigation boards required an adequate definition and a comprehensive classification and coding system of aircrew coordination (AC) errors to assist in their investigation and reporting of AC-related accidents. To meet this requirement, the U.S. Army Research Institute (ARI) tasked DRC to develop a set of procedures for identifying, classifying, and reporting AC errors as a causal factor in aviation accidents. Building upon the taxonomy of AC errors identified in a previous phase of ARI research, specific investigation and reporting procedures were developed and documented in the form of a supplemental handbook containing revised reporting forms for Army accident investigators. Army accident investigators were provided training in the definition of AC errors and use of the new procedures. The new procedures were subjected to a field demonstration and evaluation as part of three Glass A helicopter accident investigations conducted during the Summer of 1990.

Author

A92-44946
LESSONS FROM CROSS-FLEET/CROSS-AIRLINE OBSERVATIONS - EVALUATING THE IMPACT OF CRM/LOFT TRAINING

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

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National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
BEHAVIORAL INTERACTIONS ACROSS VARIOUS AIRCRAFT TYPES - RESULTS OF SYSTEMATIC OBSERVATIONS OF LINE OPERATIONS AND SIMULATIONS


The NASA/UT Line/LOS checklist is designed to capture critical components of crew interaction. The behaviors deemed critical to flight crew interaction include briefings, communications, inquiry, assertion/advocacy, and decisions communicated and acknowledged. Data shows significant behavioral interaction differences as a function of aircraft type, indicating that crew size and technology level were at least partly driving that difference. R.E.P.

BEHAVIORAL INTERACTIONS ACROSS VARIOUS AIRCRAFT TYPES - RESULTS OF SYSTEMATIC OBSERVATIONS OF LINE OPERATIONS AND SIMULATIONS


The performance of any flightcrew at any given time is determined by multiple factors ranging from characteristics of individuals such as fatigue and stress to the regulations governing flight operations. Attention is given to microcoding of communications, survey data on crewmember attitudes as indicators of culture and crew resource management (CRM) training effects, and systematic observation of crew behavior. Consideration is given to advanced CRM training of evaluators, analyses of crew behavior by aircraft type and characteristics, and survey data on crew reactions to line oriented flight training. R.E.P.

THE IMPACT OF INITIAL AND RECURRENT COCKPIT RESOURCE MANAGEMENT TRAINING ON ATTITUDES

CHERYL M. IRWIN (Texas, University, Austin) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1. Columbus, OH, Ohio State University, 1991, p. 344-349. refs (Contract NCC2-286)

It is noted that previous analyses of the boomerang effect (attitude change as a result of training in the direction opposite to that intended) in aviation training environments were limited in that each subscale of the cockpit management attitudes questionnaire (CMAQ) was treated independently. This study develops and utilizes a new algorithm for grouping subjects such that a global attitude change score is derived from the attitude change scores on each CMAQ subscale. By evaluating global attitude change in addition to the more specific attitude change on each subscale, it might be possible to better comprehend the effects of crew resource management training on pilot attitudes. R.E.P.

A REVIEW OF THE CHARACTERISTICS OF INCIDENT AND ACCIDENT REPORTING SYSTEMS - A NATIONWIDE SURVEY OF USERS


A review is presented of the Navy's aircrew coordination training (ACT) program to change the attitudes of naval aviators toward safety. 150 incident and accident reports were abstracted to be
used for training aircrews as part of a human factors problems course presented in a seminar discussion setting. The synopses are 'sanitized' to delete all references to names, squadrons, locations, and dates so that the seminars may be conducted in a nonconfrontational style to prevent the development of hostile attitudes towards the training.

R.E.P.

A92-44954
PILOT REACTION TO ULTRA-LONG-HAUL FLYING

A study is presented of a series of interviews conducted with 34 pilots, all of whom were regularly flying sectors of 12-15 hours duration. The most significant result from these interviews was that 23 of the pilots (67.7 percent) had a very strong dislike for long-haul flying while the remaining 11 (32.3 percent) believed it to be an excellent type of operation for them. Thus, ultralong-haul flights brought out strong positive or strong negative feelings with no compromises.

R.E.P.

A92-44955
TEAM BUILDING FOLLOWING A PILOT LABOUR DISPUTE - EXTENDING THE CRM ENVELOPE

An overview is presented of the problems created by the shutdown of Australia's domestic airline industry in 1989 and some of the programs initiated to alleviate the damaging effects of the closure. Team building workshops were developed to provide a forum for open discussion of the key issues involved in the shutdown as experienced by participants. These workshops promoted an increased awareness of the human factors, crew performance and flight safety implications of the pilot's new work environment.

R.E.P.

A92-44956
EXOGENOUS AND ENDOGENOUS DETERMINANTS OF COCKPIT MANAGEMENT ATTITUDES

During a selection campaign of cockpit crews for a charter airline 768 licensed airline pilots were examined with a temperament-structure-scales (TSS) multidimensional personality questionnaire and the cockpit management attitudes questionnaire. The TSS-scales and prior flight experience data were compared as determinants of differing cockpit management attitudes. Implications for the predictive power and construct validity of the TSS and the CMAQ are discussed.

R.E.P.

A92-44957
TAXONOMY OF CREW RESOURCE MANAGEMENT - INFORMATION PROCESSING DOMAIN
CHARLOTTE FREEMAN (Samford University, Birmingham, AL) and DAVID A. SIMMON (United Airlines, Chicago, IL) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1. Columbus, OH, Ohio State University, 1991, p. 391-397. refs

A taxonomy has been developed for crew resource management in an effort to identify specific types of errors and the corresponding training skills and strategies to reduce human error. Information processing was chosen for domain development following an analysis of over 500 incidents and accidents that in most cases information was available that could have been employed to prevent the incident. The taxonomy also reinforces the primary role of the pilot as an information processor.

R.E.P.

A92-44958
COCKPIT RESOURCE MANAGEMENT - A SOCIAL PSYCHOLOGICAL PERSPECTIVE

The field of social psychology, due to its sensitivity to the effects of interpersonal and situational factors on individual and group behavior, may provide some useful insights as advanced technology and automated systems change the roles and functions of crew members. Especially relevant for cockpit resource management (CRM) are the subfields of social cognition/attention and group dynamics. Each of these areas are described and related to CRM and the growing importance of these areas in light of advances in technology and automation are discussed.

R.E.P.

A92-44959
A NEW GENERATION OF CREW RESOURCE MANAGEMENT TRAINING

The nature of the evolution and the present capability of crew resource management programs are discussed. This paper focuses on the training strategy that was adopted in the late seventies as a reaction to incidents and accidents caused by human factors and to determine how the training strategy has changed as a result of lessons learned. It is indicated that most contemporary programs continue to follow the training strategy of 1978, while demonstrating some positive evolution from academic-oriented training to activity-oriented training.

R.E.P.

A92-44960
KLM FEEDBACK AND APPRAISAL SYSTEM FOR COCKPIT CREW MEMBERS

Within KLM extensive research has taken place to design a performance appraisal system for nontechnical skills for cockpit crew members. Recently KLM has redefined job descriptions for the position of captain, first and second officer and flight engineer in order to integrate technical and nontechnical performance aspects into homogeneous and coherent job profiles. After redefining these job profiles, it was decided to construct a performance appraisal system that covers nontechnical job aspect. In this paper a detailed description will be given of the process of designing this appraisal system that has been labeled as FAS: Feedback and Appraisal System for Cockpit Crew Members.

Author

A92-44961
APPLICATION OF INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD) PRINCIPLES TO THE ADVANCED QUALIFICATION PROGRAM (AQP)

An overview of the AQP that is designed to integrate a number of technical and nontechnical features and factors to enhance crew member performance when compared to traditional programs is presented. The principal factor is true proficiency-based qualification and training that is systematically developed, maintained and validated. The result of the employment of the ISD process and proficiency
based objectives will make aircrew training more responsive to changes in aircraft and instructional technology advances and implementation by the airlines more flexible, effective and possibly less costly without affecting safety.

R.E.P.

A92-44962
PERSONALITY DIFFERENCES AMONG SUPERVISORY SELECTION PROGRAM CANDIDATES

This study examines the supposition that persons who strive for achievement, with the accompanying cost in irritability and impatience characterizing the Type A behavioral syndrome seen among controllers, would more likely succeed in completing multiple hurdles in a supervisory selection process. Logistic regression is employed to test this hypothesis. The analyses demonstrated that achievement striving and impatience/irritability did not provide useful information about characteristics predicting completion of multiple hurdles in the selection process.

R.E.P.

A92-44963
ATCS FIELD TRAINING PERFORMANCE AND SUCCESS IN A SUPERVISORY SELECTION PROGRAM

A discussion of the types of air traffic control facilities is presented and the various training programs provided by each facility type are described. The question of whether the available measures of technical performance that were found previously to be predicted by selection test scores are in turn predictive of success in the supervisory identification and development program is examined. It is shown that for air traffic controllers in general, the mean instructor rating assigned during on-the-job technical training is predictive of whether the controller passes the peer/supervisory assessment and continues in the supervisory selection and development process.

R.E.P.

A92-44964
CANDIDATE PERFORMANCE IN A SUPERVISORY SELECTION PROGRAM AND SUBSEQUENT SELECTION DECISIONS

It is noted that the FAA previously implemented the Air Traffic Supervisory Identification and Development Program (SIDP) to change the emphasis on technical performance in promotability decisions to include other skills, such as communication and decision-making, that reflect supervisory potential. This report examines whether measures of technical performance distinguish between successful versus unsuccessful candidates at different phases of the SIDP while also examining specific measures of SIDP performance. The results of the analysis of the referral variable identified important differences between the referred and not referred groups on the peer-supervisory assessment performance and dimensions ratings.

R.E.P.

A92-44965
PERFORMANCE IN THE ATC SCREEN PROGRAM AND SUPERVISORY SELECTION PROGRAM OUTCOME

A study is presented to examine the relationship between performance in the FAA Academy screening programs and the supervisory selection program ratings of the supervisory identification and development program (SIDP) applicants. The purpose of this study was to investigate the hypothesis that ATC Specialist applicants to the SIDP program who were successful in the first stage of selection, had shown better performance in the Academy programs. Results of the analyses demonstrated that there were small but statistically significant correlations between all of the Academy measures and the peer/supervisory assessment technical rating, except for the controller phase test, for the en route option.

R.E.P.

A92-44966
COGNITIVE INDICATORS OF ATCS TECHNICAL ABILITY AND PERFORMANCE IN A SUPERVISORY SELECTION PROGRAM

A study was developed to determine the relationship between entry level information of an applicant's cognitive capabilities (aptitudes) to function as an ATC Specialist (ATCS), as measured by the OPM selection battery, and subsequent selection as a potential supervisor through the SIDP. Specifically, the interest is in determining if scores on the initial selection tests predict technical performance ratings received by the SIDP applicants. Given the current measures of aptitudes for the ATCS profession there was little support shown for any relationship between these aptitudes and either overall ratings during the skill based interview or selection as a supervisor.

R.E.P.

A92-44970
EXPLORING CONCEPTUAL STRUCTURES IN AIR TRAFFIC CONTROL (ATC)

Air traffic control (ATC) is a complex domain. To be meaningful and useful, research and applications must embrace this complexity. This study used Pathfinder network analysis to gain insight into air traffic controllers' representations of the relationships between ATC concepts. Two groups of controllers differing in years of experience and a control group of financial analysts provided ratings of the relatedness of pairs of selected ATC concepts. Various substructures within the derived networks revealed features of ATC domain knowledge as well as subtle differences between the two groups of controllers. These findings have tentative implications for ATC training, aiding, and incident/accident data-base organization.

Author

A92-44971
APPLYING COGNITIVE INSTRUCTIONAL SYSTEMS DEVELOPMENT TO MULTINATIONAL AIRWAYS FACILITIES TRAINING

This paper discusses applications of Instructional Systems Development (CISD) in developing training for electronics technicians maintaining ground to air navigational aids systems. Cognitive ISD is defined as an approach to instructional systems development that incorporates selected principles of both behavioralism and cognitive psychology. Cognitive ISD may be distinguished from other applications of Instructional Systems Development through consideration of selected factors, including mental representation, critical reflection, automated behaviors, learner control, and an orientation toward learner-centered experimental knowledge acquisition resulting in competence.

Author

A92-44972
COGNITIVE TASK ANALYSIS OF AIR TRAFFIC CONTROL

345

A92-44973
THE HUMAN ELEMENT IN AIR TRAFFIC CONTROL (ATC)

This report focuses on the decision of where to draw the line on the human-computer interface that will likely become critical to the continued safe and efficient management of the air traffic control system. Automation of the ATC system is gradually shifting this work from one of intense personal involvement and individual performance to one of monitoring the performance of machines. The solution to this human-machine interface problem will necessitate close cooperation between the technologists and the psychologists, but it is noted that the potential payoffs in system performance, capacity, and safety gains should be extensive. R.E.P.

A92-44974
INFORMATION TRANSFER LIMITATIONS IN ATC

This paper analyzes the historical role of air traffic controller information transfer, the limitations which lead to operational errors, slips, incidents and accidents, and the need for specialized training to combat and overcome these limits. Human attributes which contribute to information transfer deficiencies are discussed. The impact of distractions, forgetting, failure to monitor, expectancy and complacency on the controller’s job performance are illustrated by using operational error data and examples. Author

A92-44978
THE HUMAN FACTORS OF TEAM-BUILDING IMPLICATIONS FOR AB INITIO TRAINING

A review is presented of certain NTSB data identifying several incidents that involved controller coordination problems. Problems with role ambiguity, situational awareness, supervision, and workload were frequently cited, and in more than one case, the experience level of a controller or pilot may have been partly to blame. These data indicate that communication and coordination in the NAS are inadequate, and that these problems may be intensified to an unacceptable degree when pilots and controllers are less than fully proficient. R.E.P.

A92-44980
TAXONOMY OF ATC OPERATOR ERRORS BASED ON A MODEL OF HUMAN INFORMATION PROCESSING

Despite air transportation’s outstanding safety record, increasing demand for air transportation services coupled with limits to facilities and air space is creating an increasing load on the ATC system. Air traffic controllers are subject to the same cognitive and perceptual limitations as any operator of any complex system and the consequences of errors they commit can be catastrophic. A study is presented to contribute to the understanding of the human error in the ATC domain and how to moderate its consequences. R.E.P.

A92-44984
VISUAL CUES TO GEOGRAPHICAL ORIENTATION DURING LOW-LEVEL FLIGHT
VERNOL BATTISTE (NASA, Ames Research Center, Moffett Field, CA) and SUZANNE DELZELL (San Jose State University, CA) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1. Columbus, OH, Ohio State University, 1991, p. 538-543. refs

A field study of an operational Emergency Medical Service (EMS) unit was conducted to investigate the relationships among geographical orientation, pilot decision making, and workload in EMS flights. The data collected during this study were compared to protocols gathered in the laboratory, where pilots viewed a simulated flight over different types of unfamiliar terrain and verbally identified the features utilized to maintain geographical orientation. The EMS pilot’s questionnaire data were compared with data from non-EMS helicopter pilots with comparable flight experience. R.E.P.

A92-44987
PSYCHOLOGICAL STATE VS. PERIPHERAL COLOR PERCEPTION

Subject psychological state (normal, stressed, relaxed) affected the peripheral location of where the three primary colors could be correctly perceived utilizing a CRT as the display medium. For the normal baseline state a 1.3-deg circle of blue could not be seen further than 83.1 deg of the fovea (along the x-axis). Red had to be closer than 76.3 deg and green nearer than 74.3 deg before the subjects reported seeing the colors. A significant degree of “visual field narrowing” was noted for the relaxed state with a threshold of 19.8 deg. No significant differences were noted between the peripheral by relaxation but only stress. These color-perception limitations induced by pilot psychological state must be kept in mind when designing CRT color formats for aircraft cockpits. Author
A92-44988
TARGET ACQUISITION PERFORMANCE USING SPATIALLY CORRELATED AUDITORY INFORMATION OVER HEADPHONES

An effort to reduce information overload of pilots has focused on the recently proven capability to provide doppler information over headphones utilizing electronically synthesized auditory localization cues. A study is presented on the utility of this headset localization capability when applied to a practical visual target acquisition task that is emulated in the laboratory environment. The investigation attempts to isolate the target acquisition task from the other workload tasks, noise, and psychological stresses that a pilot experiences while flying, to provide a controlled testing environment.

R.E.P.

A92-44989
DYNAMIC CONTRAST SENSITIVITY

The development of a device and materials for the measurement of dynamic contrast sensitivity and an initial comparison of static and dynamic contrast sensitivity over a wider range of spatial frequencies are presented. The materials and procedure of this investigation provide contrast sensitivity data comparable to that of VisTech Vision Contrast Sensitivity System. Peak sensitivity is the same, but occurs at a higher spatial frequency for the VisTech, i.e., 6 vs 4.25 cycles/deg.

R.E.P.

A92-44990
RELATIONSHIP BETWEEN SURFACE TEXTURE AND OBJECT DENSITY ON JUDGEMENTS OF VELOCITY, ALTITUDE, AND CHANGE OF ALTITUDE

The simulation of low-level flight has traditionally been difficult for computer image generation systems because of the amount of data required to be rendered. When the visual scene must be transformed. Due to limitations in computing resources, computer-generated scenes must be significantly simplified in order to maintain real-time capabilities. In the course of this simplification it is important to retain the necessary perceptual cues to maintain situational awareness. The purpose of this exploratory study was to investigate the effect of varying two types of ground texture and three levels of object density on the observers ability to judge velocity, altitude, and change of altitude during low level flight. It was predicted that by increasing the density of objects and the realism of the computer-generated terrain performance would improve for the above three measures of situational awareness. The results indicated that the main effect for object density and terrain realism were not significant for estimates of velocity and altitude, however for altitude population, estimates of the shift in altitude varied as a function of object density.

Author

A92-44991
A SURVEY OF NAVAL AVIATOR OPINIONS REGARDING UNAIDED VISION TRAINING TOPICS

A sampling among Navy and Marine Corps pilots regarding the importance of traditional unaided vision training is presented. Participants were given a series of topics, each including an explanation of a visual deficiency and a matrix for rating the frequency of the problem in a variety of operational scenarios. This analysis revealed findings that include evidence of fleet acceptance for each of the surveyed aviation physiology vision training topics.

R.E.P.

A92-44992
USE OF A HUMAN FACTORS CHECKLIST IN AIRCRAFT MISHAP INVESTIGATIONS

An account given of the development and potential applications of a human-factors checklist devised for the clarification of chains of causality relating to pilot/crew involvement in accidents and incidents. The checklist which has been devised for U.S. Navy/Marine use is meant to function both as a user-friendly investigation tool, and as the basis for a safety program that addresses key preventive factors in aircrew-related mishaps. The classification-structure of the checklist encompasses sensory-perceptual, knowledge-skill, medical-physiological, communications-ordination, decision-judgment, and attitude-personality, as well as supervisory and design-systemic factors.

O.C.

A92-45001
BEHAVIORAL ANALYSIS OF MANAGEMENT ACTIONS IN AIRCRAFT ACCIDENTS

The sources of aircraft accidents in easily overlooked management actions, directives, and broad policies are presently illustrated in view of three aircraft accidents and one railway accident. Attention is given to psychological factors characterized as 'latent errors'; the analysis presented showed that the nonproximate factors accounting for the accidents were related to management policies via the reinforcing effects of the individuals or groups more proximately involved. It is shown that the behavior of managers at different levels must be analyzed to determine the extent of said reinforcement.

O.C.

A92-45003
THE MYTHS OF PILOT PERSONALITY STEREOTYPES

The present evaluation of existing pilot personality/aptitude selection criteria argues that no current method can adequately distinguish high-performance pilots from others. The bases of many such methods' assumptions are noted to be unsustainable stereotypes associated with popular stereotypes of military pilot behavior. There is accordingly a significant danger that aviation managers are being poorly advised and misled by behavioral stereotypes, biased, inept, and suboptimal work. Extensive efforts toward the validation and cross-replication of aptitude evaluations are required.

O.C.

A92-45004
COMPARATIVE ANALYSIS OF MMPI PROFILES IN TWO GROUPS OF AB-INITIO FLYING TRAINEES
GURMUKH SINGH (Institute of Aerospace Medicine, Bangalore,
53 BEHAVIORAL SCIENCES


The Minnesota Multiphasic Personality Inventory (MMPI) psychological testing system has been used to ascertain the personality profiles of two groups of trainees under high stress conditions reflective of training in instrument flying, low level navigation, close formation, night flight, aerobatics, and long range flight. It is established that while normal subjects obtained MMPI profiles identical to those of a control group, subjects of an aberrant group exhibited a gross abnormality in their MMPI results relative to the control group.

A92-45005
THE MYTH OF THE ADVENTUROUS AVIATOR

Experience obtained with hundreds of aviators from various airlines in cockpit resource management (CRM) courses suggests that many personality types are represented among young pilots. The use of reliable psychological aptitude measures also indicates that 'independent-minded' and 'adventurous' individuals may not dominate the profession. These attitudinal data have important implications for several areas of pilot training, by allowing a more careful tailoring of CRM and similar educational efforts to personality profiles.

A92-45006
INAPPROPRIATE FUNCTIONING OF THE COCKPIT DOMINANCE HIERARCHY AS A FACTOR IN APPROACH/LANDING ACCIDENTS

This paper introduces the hypothesis that a major factor influencing the behavior of subordinate crew members is the cockpit dominance hierarchy and that it adversely affects the behavior of the whole crew in certain critical situations. This extension of Milgram's classical work on authority and obedience is presented as a contribution to the development of cockpit resource management (CRM). While the influence of the dominance hierarchy permeates the basic concept of CRM, a review of the literature, while not exhaustive, shows no evidence of this subject being directly addressed.

A92-45009
PROFESSIONAL PILOTS' EVALUATION OF THE EXTENT, CAUSES, AND MEANS OF REDUCTION OF ALCOHOL USE IN AVIATION
SUSAN M. ROSS and LEONARD E. ROSS (Wisconsin, University, Madison) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2, Columbus, OH, Ohio State University, 1991, p. 728-733. refs

Questionnaires were sent to a sample of 1000 pilots; of the 983 delivered, a return rate of 61.5 percent was achieved. The questionnaires posed questions as to the respondent's aviation experience and solicited characterizations of the extent to which alcohol abuse is a problem in aviation. The results of the survey indicate that while the respondents are aware of cases of alcohol abuse, they see these as isolated and due to factors involving the psychology of individuals.

A92-45013
EFFECTS OF GYRO-FITNESS TRAINING ON AIRSICKNESS MANAGEMENT

An effort is made to experimentally assess whether that USAF Academy's eclectic approach to the treatment of trainee airsickness conditions will succeed in the acceleration of airsickness recovery rates. Attention is given to the effectiveness of the 'Equinox trainer', a man-sized, two-axis-of-motion gyroscope, which induces vestibular acceleration and visual tracking requirements similar to those encountered in flight. The data obtained are judged to be insufficient for the determination of a definite reduction of airsickness symptoms as a result of such 'gyrofitness training'.

A92-45017
THE INTERACTIVE EFFECTS OF COCKPIT RESOURCE MANAGEMENT, DOMESTIC STRESS, AND INFORMATION PROCESSING IN COMMERCIAL AVIATION

An effort is made to characterize the interactivity of domestic stress, information processing degradation, and pilots' cockpit-resource management (CRM) training, on the basis of responses to a survey. The analysis of survey results indicates that both domestic and aviation stress have increased for the majority of aircrew samples, and that the majority of airline pilots experienced a degradation of information-processing capability when under aviation or domestic stress. The vast majority of those pilots underwent an enhancement of information processing when subjected to Aircrew Team Dynamics training.

A92-45018
THE FROZEN PILOT SYNDROME

Accounts are given of cases in which experienced pilots become fixated in emergencies upon a narrow aircraft-control factor or activity to the exclusion of all others. In such cases, the pilot's cognitive processes have for all intents and purposes ceased, as they become obsessively concerned with an inappropriate action that does nothing but appear to relieve psychological stress. It is presently argued that the accident-investigation process may yield information useful in the identification of individuals that are susceptible to this syndrome.

A92-45019
FLIGHT ANXIETY OF CIVILIAN STUDENT PILOTS

The results of a study which measured the predictors of flight anxiety in civilian student pilots are presented. Such preflight predictors of anxiety as insomnia, fatigue, apprehension, restlessness, etc., were correlated with high anxiety levels to a degree that allowed their use as predictors. High anxiety significantly correlated with such physiological outcomes as faintness, nausea, airsickness, and greyout/blackout. Fully 49 percent of pilots in this study had experienced insomnia within the 24 hours prior to their next flight.

A92-45022
INCREMENTAL TRANSFER STUDY OF SCENE DETAIL AND VISUAL AUGMENTATION GUIDANCE IN LANDING TRAINING
HENRY L. TAYLOR, GAVAN LINTERN, JEFFERSON M. KOONCE,
Beginning flight students were taught landings in a flight simulator with a visual landing display to examine the effects of scene detail, visual augmented guidance, and the number of landing training trials. Transfer as assessed in a criterion simulator configuration showed advantages for larger numbers of training trials, visual augmented guidance, and moderate scene detail. Subjects who had received landing training in the simulator, however, showed no advantage in transfer to the airplane compared to control subjects who received an equal amount of simulator time practicing an instrument pattern. While it is clear that training manipulations using a computer graphics visual display can impact the acquisition of landing skills as assessed by testing in the simulator, the conditions under which skills learned in the simulator transfer to the aircraft are not clear. 

Author

**A92-45023 VISUAL AUGMENTATION AND SCENE DETAIL EFFECTS IN FLIGHT TRAINING**


Flight students were taught landings in a flight simulator with a visual landing display to examine the effects of high- and low-detail scenes, adaptive and no visual augmentation (command and/or guidance), and fast, normal and slow roll response on the acquisition and transfer of landing skills. Transfer was assessed in the simulator with a high-detail pictorial scene, no visual augmentation, and a normal roll response. Training with visual augmentation was superior to training without it. Guidance augmentation enhanced transfer only when it was combined in training with the low-detail scene. 

Author

**A92-45024 VISUAL PROPERTIES FOR THE TRANSFER OF LANDING SKILL**


Flight naive subjects flew landing approaches in a simulator with a computer animated visual display under different settings of visual augmented feedback, scene content, training headwinds, and transfer headwinds. The use of augmented command feedback in training enhanced glideslope tracking performance in training and in transfer, but the nature of the enhancement differed in that stability was affected in training and bias was affected in transfer. Biasing effects were also observed in probe trials (inserted into the transfer session) in which various forms of visual information were distorted or removed. For texture gradient added to or deleted from the ground plane, the glideslope bias of subjects trained with constant command augmentation or with no command augmentation was affected. There was no such effect for subjects trained with adaptive command augmentation. These data suggest that the different command augmentation schedules tested in this experiment oriented subjects to different visual properties that can support glideslope control. 

Author

**A92-45037 COMPUTER-BASED PROCEDURAL TRAINING**


The potential latent in the use of inexpensive PCs to serve as the bases of 'part-task trainers' allowing systematic interaction between student and simulator device, with the appropriate feedback and automatic scoring of student performance, has not been fully exploited by the aviation industry. Attention is presently given to the training effectiveness of a procedures trainer manufactured from full-scale computer-drawn artwork with touchpoints for each switch, gage, and control. Three experiments were conducted with the device, using flight-naive subjects; the results obtained show that the imposition of a rigid order on procedural tasks aids learning. 

O.C.

An effort is made to ascertain the statistical relationship of each candidate measure for air combat engagement outcomes, as well as to determine the relative importance of each measurement category for the prediction of engagement outcome. A composite measure of performance from all candidate measures which maximizes the prediction of engagement outcome is devised. The adversary model used was the Adaptive Maneuvering Logic. The most salient result from analysis of the candidate measures was the very powerful effect of 'opponent type'; all multivariate analyses accordingly had to be conducted separately for each type of opponent. O.C.


Experienced pilots attempting to master new aircraft must learn how to recognize cues that signal problems with either the acquisition of critical new information or interference in effective interaction among crewmembers. An 'assertiveness training program' may be required for effective interaction in the cockpit environment. Attention is given to the 'concept mapping' method for decomposing an individual's ideas into relational components, in order to identify anomalies which may be acting as barriers to learning. O.C.


It is feedback which ultimately allows the student pilot to understand the full implications of cockpit indicators and take appropriate and timely actions. In order to assist in the imparting of these skills, a type of computerized instructional resource, designated an 'expert critic' or 'evaluator', has been developed to generate and deliver an extensive feedback message concerning: (1) a specific student performance goal, (2) a free-play simulated environment of defined scope, (3) a record of student activities within the simulated environment, or (4) a complete feedback review of student performance following the requisite interactions. O.C.

A92-45050*  NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. Ames Research Center, Moffett Field, CA.


An effort is made to ascertain which combinations of technical demands and crew coordination should be incorporated in training scenarios in order to maximize the effectiveness of training for crew members. Such high-fidelity simulation, which has come to be known as 'line-oriented flight training' or LOFT, involves the practice of both technical and crew coordination skills in a realistic setting, in conjunction with periodic reviews of performance via videotaped feedback. Attention is given to the integration of appropriate information, the measurement of objective task demands, the character of information from LOFT students, and the leeway allowed LOFT instructors. O.C.

A92-45053  NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. Langley Research Center, Hampton, VA.

ON OPERATOR STRATEGIC BEHAVIOR  P. A. HANCOCK (Minnesota, University, Minneapolis) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 999-1007. Research supported by NASA. refs

(Contract NAS1-1118)

Deeper and more detailed knowledge as to how human operators such as pilots respond, singly and in groups, to demands on their performance which arise from technical systems will support the manipulation of such systems' design in order to accommodate the foibles of human behavior. Efforts to understand how self-autonomy impacts strategic behavior and such related issues as error generation/recognition/correction are still in their infancy. The present treatment offers both general and aviation-specific definitions of strategic behavior as precursors of prospective investigations. O.C.

A92-45057*  NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. Ames Research Center, Moffett Field, CA.


(Contract NASA ORDER A-72145-C)

A theoretical framework has been synthesized for the use of cognitive processes to understand team functions. Three different pilot-copilot-flight engineer cockpit crews were observed over the course of a set of mission conducted in a B-727 simulator at NASA-Ames. Only experienced commercial aviators were used in positions for which they were officially qualified; one of the flights involved a generator malfunction, and another was marked by a serious fuel leak. All flights were videotaped and shown to the crews immediately after each session. Transcripts prepared from these videotapes logged the person uttering each comment and the exact time of the comment. O.C.

A92-45058*  NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, Washington, DC.

WHY PILOTS ARE LEAST LIKELY TO GET GOOD DECISION MAKING PRECISELY WHEN THEY NEED IT MOST  JOHN W. MAHER (Delta Airlines, Centerville; Harvard University, Cambridge, MA; NASA/University of Texas Aerospace Crew Research Center, Austin) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 1032-1037. refs

Studies of commercial aircraft incidents and accidents indicate that, in flight conditions not covered by standard operating procedures, as well as when the environment is saturated with information or unmanaged stress, cognitive shortcuts dominate aircrews' decisionmaking processes. Multidisciplinary research on such situations with high-fidelity simulators becomes critically important, as do psychometric tools which examine vigilance, personality resiliency before stressful conditions, and decisional and interpersonal mind-sets. O.C.


All aviation activities should be so structured that pilots will be compelled to take actions only within that range of factors most
directly conducive to the maintenance of safety in matters of perception, stress, and workload. System design should stress the quality of pilot perception and the availability of suitable reaction time. Difficulties will inevitably arise, however, in the ability of the pilot to analytically identify the reasons for malfunctions.

O.C.

A92-45060
FLYING AN AIRCRAFT AS A PROBLEM SOLVING PROCESS - ABOUT THE INSTRUMENT-FAILURE-SIMULATOR (IFS) AS A TEST FOR PILOT APPLICANTS


On the basis of a theoretical model about how pilots fly an aircraft, an Instrument-Failure-Simulator (IFS) was developed. The simulator is equipped with instruments that systematically malfunction. The task for the subjects is to fly and follow a rather simple track several times while scanning the instruments for failures. The performance is rated on the basis of the distance between the actual flight path and the given track as well as the ability to detect instrument failures. The results indicate that the IFS can be used to predict professional success.

Author

A92-45061
TOWARDS THE VALIDATION OF THE FIVE HAZARDOUS THOUGHTS MEASURE

M. LUBNER, M. PHIL, and J. MARKOWITZ (Columbia University, New York) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 1049-1054. Research sponsored by FAA. The 'five hazardous thoughts scale', a self-evaluation test that can be conducted with pencil and paper, proceeds from the discovery by Jensen and Benel (1977) that decision errors constituted the largest category of causes of aviation fatalities. The 'subscales' for which the test is named are: (1) antiauthority, (2) invulnerability, (3) macho, (4) impulsiveness, and (5) resignation. The test covers five scenarios with five evaluated items in each, furnishing a total of 25 items; each item is scored from 1 = not likely to 5 = highly likely. It is experimentally established that, with some additional refinement, the scale may be predictive of dangerous aviation occurrences.

O.C.

A92-45062
THE PILOT JUDGEMENT STYLES MODEL SUPER C - A NEW TOOL FOR TRAINING IN DECISION-MAKING


The present framework for pilot problem-solving-related analysis and training tasks is concerned with the individuals' ability to recognize problems, process information, recall previously encountered information, generate alternatives, and evaluate the risks associated with each alternative. Also involved is the motivational or 'attitudinal' dimension of decisionmaking, which entails recognition of hazardous attitudes that can affect decisionmaking and compels the fostering of those attitudes which will lead to selection and execution of safe courses of action.

O.C.

A92-45065
KNOWLEDGE TRANSFER AND ANTICIPATION IN AIRLINE PILOTING


The methods of cognitive psychology are presently used to study the problem of knowledge transfer when pilots convert to a new aircraft, giving attention to the 'anticipatory' aspect of pilot cognitive activities. Anticipatory competence allows pilots to predict the evolution of a flight and thereby dynamically generate suitable plans of action. A set of hypotheses is formulated for the relationship between anticipation and knowledge transfer, and training tools based on them are derived.

O.C.

A92-45066
INFORMATION PROCESSING IN AB INITIO PILOT TRAINING


While information-processing proficiency can affect an individual's learning and task-related performance, little effort has been made to teach this skill during pilot training, and there is accordingly a poor harnessing of cognitive and metacognitive skills associated with strategic information processing. Attention is presently given to a pilot program which evaluated the idiosyncracies of each pilot-training candidate's information-processing styles; the cognitive profile thus obtained becomes the groundwork for instruction aimed at the development of cognitive and metacognitive capabilities, on the basis of self-monitoring/self-evaluation.

O.C.

A92-45067
THE EFFECTS OF UNIQUE ENCODING ON THE RECALL OF NUMERIC INFORMATION

ELIZABETH PARKER-HANEY (San Jose State University, CA) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 1089-1094. refs

In order to determine the suitability of the digit-by-digit transmission of numeric data to pilots, the present experiment examined pilots' short term memory span by auditorily presenting air traffic control messages with one of two presentation formats: digit-by-digit or the unique 'chunked' transmission. Data analysis revealed that there were no significant differences in recall between the digit-by-digit and the chunking conditions. However, analysis of message type and length of retention interval revealed significant main effects and interactions. The importance of errors found in recall and the error types are also discussed.

O.C.

A92-45068
ROLE OF PILOT'S METAKNOWLEDGE OF THEIR OWN RELIABILITY AND CAPABILITIES


'Metaknowledge', which is ever-present in piloting activities, contains an individual's 'log' of experiences on the basis of general cognitive tools, whereby associating technical procedures with a personal approach to the management of cognitive resources. An investigation is presently conducted of the kind of knowledge which pilots gather to adjust domain-dependent rules, individual range of adaptation, and efficiency. Attention is given to two forms of metaknowledge: the cataloging of known procedures and actions, and the representation of cognitive competencies.

O.C.

A92-45069
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AME Research Center, Moffett Field, CA.

AN EVALUATION OF STRATEGIC BEHAVIORS IN A HIGH FIDELITY SIMULATED FLIGHT TASK - COMPARING PRIMARY PERFORMANCE TO A FIGURE OF MERIT


Contract NCC2-486

The usual method of evaluating flight performance during a simulation is to collect as many primary performance measurements...
as possible. Then analyze all the measurements to find one sensitive to the manipulations imposed on the pilot during the scenario. Although this method can be useful, it is usually unreliable from one study to another. A simulation was conducted to test an integrated figure of merit (FOM) constructed using a standardized procedure. Pilots flew two full-mission scenarios in an instrument trainer with three degrees of freedom. The primary performance measurements selected assessed the pilot's performance in accuracy, smoothness, and activity. The results suggest that the integrated FCMs performed comparably to the primary performance measurements in determining which flight information the higher demands on the pilot. The standardized construction process allow adjustments to the FOM, so it can be used in different applications.

A92-45070* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE EFFECTS OF TASK DIFFICULTY AND RESOURCE REQUIREMENTS ON ATTENTION STRATEGIES

The pattern of attention strategies for task difficulty/resource tasks vary. For which experimental results are presented and analyzed support the hypothesis that subjects may adopt an alternating (rather than concurrent one) when compelled to do so by either the size or the complexity of a visual display. According to the multiple resource model, if subjects had been performing the two tasks concurrently, the cost of this strategy would have been shown by a decrement in the spatial format, rather than the verbal format, due to competition for the same resource. Subjects may apply different strategies as a function of task difficulty and/or resource demand.

A92-45071 THE STRATEGIC INTEGRATION OF PERCEPTION AND ACTION

Although highly skilled action in dynamic visual environments is believed to require an ongoing orchestration between perception and action, there is little research that directly examines this relation. Preliminary findings are reported from a laboratory designed to examine the real-time coordination between eye movements and skilled action. Expert subjects performed a video-game task that involved selecting targets and judging intercept times in a dynamic and cluttered visual environment. The results showed a high degree of correspondence between looking and acting and suggested that performers obtain specific visual information within specific time intervals to calibrate future action.

A92-45072* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MULTI-ATTRIBUTE TASK BATTERY - APPLICATIONS IN PILOT WORKLOAD AND STRATEGIC BEHAVIOR RESEARCH
RUTH J. ARNEGARD (Old Dominion University, Norfolk, VA) and J. R. COMSTOCK, JR. (NASA, Langley Research Center, Hampton, VA) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 1118-1123. Previously announced in STAR as N92-17130. refs

The Multi-Attribute Task (MAT) Battery provides a benchmark set of tasks for use in a wide range of lab studies of operator performance and workload. The battery incorporates tasks analogous to activities that aircraft crewmembers perform in flight, while providing a high degree of experimenter control, performance

A92-45073 STATE-OF-THE-ART PILOT PERFORMANCE AND WORKLOAD MEASUREMENT

An examination is conducted of the flexibility of human operators in dynamic and complex situations, in order to characterize how individuals schedule and prioritize tasks. Participating subjects were free to monitor their own workload, as well as evaluate the time required for performing a given set of tasks and modify those tasks at their own discretion. Thirty instrumented pilots flew simulated instrument approaches under different workload conditions; analysis of the results obtained indicates that as workload increased, pilots spent a greater portion of the available time on the higher-priority tasks, and their ability to perform those tasks remained optimal despite the increase in workload. The implications of these findings for flight training are discussed.

A92-45074 STRATEGIC BEHAVIOUR IN FLIGHT WORKLOAD MANAGEMENT

The foundational concept of the Bedford scale is that it is natural for individuals to judge the amount of space capacity that remains while they perform a task. An effort is presently made to ascertain whether subjects employing this scale could focus on the demands of one task to the exclusion of other time-shared tasks. It appears possible that a more intensive training of pilots may render them resistant to the contaminating influence of time-shared tasks; until this is experimentally demonstrated, the use of the Bedford scale to evaluate one task in a multitask cockpit environment cannot be recommended.

A group of 30 instrument-rated pilots was made to fly simulator approaches to three airports under conditions of low, medium, and high workload conditions. An analysis is presently conducted of the difference in discrete task scheduling between the group of 10 highest and 10 lowest performing pilots in the sample; this categorization was based on the mean of various flight-profile measures. The two groups were found to differ from each other only in terms of the time when specific events were conducted, and of the optimality of scheduling for certain high-priority tasks. These results are assessed in view of the relative independence of task-management skills from aircraft-control skills.

O.C.


The purpose of the USAF Pilot Selection and Classification System is to reduce pilot-training attrition rate and furnish the Air Training Command (ATC) with early classification of pilot candidates. ATC has initiated research on a structured interview designed to improve candidate selection. It is fortunate that much of the personality assessment work presently evaluated involves performance-based measures, rather than self-report inventories, in virtue of the merely weak relationship that has been found between the two by Dolgin and Gibb (1988). O.C.


CTS, a computerized battery of tasks developed by the USAF to conduct rapid, standardized evaluations of workload metrics and cognitive performance capabilities, has completed several development phases and continues to be used in cognitive studies. The task battery presented by the USN's UTC-PAB/AGARD STRES PC-compatible workload metric evaluator is similar to that of the CTS. The USAF is applying CTS experience to the evaluation of the AGARD STRES system. An effort is being made to obviate all peripheral hardware requirements that cannot be accommodated by a PC.

O.C.


The accurate assessment of cognitive abilities and personality characteristics of individuals in international groups with standardized tests is encumbered by several factors, chiefly including cultural ones. The culture-fairness of test methods that have been successfully used in national psychological assessment of aviation personnel is assessed. The influence of cultural differences among testees on a number of general aptitude and personality tests is investigated. Testees from 12 European countries took part in this study. Results indicate that cultural differences seem to affect test performance on a number of tests. However, when English language skill is controlled as a concomitant variable in an analysis of covariance, culture or nationality differences disappear on all tests. Results are discussed and recommendations for the improvement of culture-fairness of test methods are formulated. Author


A comparative analysis of current media selection models was conducted to improve key Instructional System Development (ISD) steps that would significantly benefit from automation and decision support features. Media selection models in general use by military, contractor, and civilian instructional designers were compared and contrasted. Key features that impact media selection model automation were identified. A preliminary design of an automated media selection model incorporates the requirements of as many of the reviewed media selection models as possible was developed. Author


The USAF has been applying systems approaches to the development of methods for the definition of training systems requirements and their implementation. The systems methodology further supports the integration of training efforts with other aspects of USAF operations and to establish frameworks within which operational efficiencies can be determined. O.C.


Sociocultural issues that can affect the work of space crews during long missions are briefly discussed. The most important of these issues are language differences between crew members, cultural and racial biases, gender stereotyping, and differences in career motivation. Measures that can be taken to deal with these issues are considered. C.D.

A92-46277 EFFECT OF SPATIAL FREQUENCY CONTENT OF THE BACKGROUND ON VISUAL DETECTION OF A KNOWN TARGET WILLIAM GENTLES, THAHIN NGUYEN, WILLIAM HO, CURTIS CALDWELL, LISA EHRICH, CHARLENNE LEONHARDT, and RICK REED (Toronto, University, Canada) IN: Medical imaging VI - Image processing; Proceedings of the Meeting, Newport Beach, CA, Feb. 24-27, 1992. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1992, p. 341-351. Research supported by Sunnybrook Trust for Medical Research. refs Copyright

The background of a target is varied in terms of frequency to
A92-46278

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A92-46296

A92-46300

A dyadic protocol for training complex skills

WAYNE L. SHEBILSKE (Texas A & M University, College Station), J. W. REGAN (USAF, Intelligent Training Branch, Brooks AFB, TX), WINFRED ARTHUR, JR., and JEFFREY A. JORDAN (Texas A & M University, College Station) 

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A92-46296

COLLECTIVE BEHAVIOR AND TEAM PERFORMANCE

JAMES E. DRISKELL (Florida Maxima Corp., Winter Park) and EDUARDO SALAS (U.S. Navy, Naval Training Systems Center, Orlando, FL) 


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A92-46300

A dyadic protocol for training complex skills

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A dyadic training protocol is tested which is derived from cognitive and social theories of complex skill acquisition. A video-game-like research tool is used by subjects for 10 sessions of eight practice and two test games. Half of them practiced and tested alone; the others had identical tests but dyadic practice, in which they controlled part of each practice while being interlocked with a partner who controlled the rest. Subjects practiced both parts and their connections by alternating roles and by modeling their partners. Trainer time and resources were half for the dyadic group, and performance was equivalent. This 100 percent increase in training efficiency is discussed. 

Author

A92-48548

PERIPHERALLY LOCATED CRTS - COLOR PERCEPTION LIMITATIONS

EILEEN ANCMAN (USAF, Wright Laboratory, Wright-Patterson AFB, OH) 


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Colors on a peripherally located CRT (cathode ray tube) may be misperceived. Subjects wrongly identified the color of a peripherally located, 1.3 deg circle displayed on a CRT 5 percent of the time if it was blue, 83 percent of the time if red, and 62 percent of the time if green. Blue could not be seen further than 83.1 deg off of the fovea (along the x-axis). Red had to be closer than 75.3 deg and green nearer than 74.3 deg before the subjects reported seeing the colors. These average color field dimensions changed with differing subject psychological states due to the observed visual field narrowing (i.e., reduction of the subject's peripheral field of view) in both the relaxed and stressed states. A significant degree of visual field narrowing was noted for the relaxed states (6 percent), with a trend noted for the stressed state (2 percent). It is concluded that these color perception limitations must be kept in mind when designing CRT color formats for aircraft cockpits. 

Author

N92-28396#

Human Engineering Labs., Aberdeen Proving Ground, MD. 

PROGRAM CLUSTER: AN IDENTIFICATION OF FIXATION CLUSTER CHARACTERISTICS

RAMAKRISHNA S. PILLALAMARRI, B. D. BARNETTE, ROBERT KARSH, and DEBORAH P. BIRKMIRE 

Jan. 1992 30 p 

AD-A247014; HEL-TN-1-92) 

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An innovative software technique to advance methods of analysis in eye movement research have not kept pace with the development of hardware for collecting the samples of eye position. Eye fixation and duration have been the primary measures focused upon to glean knowledge of subjects' performance while engaged in cognitive visual tasks. Program cluster was developed as a means of investigating the dynamics of target examination characteristics that did not lend themselves to traditional eye movement analysis methods. The development of this tool proved to be a valuable means of assessing visual activity at a micro level as compared to the gross measures of distribution of visual attention in various areas of the visual field. This report describes the history surrounding the development of program cluster as an analysis tool, the source of input required for its execution, the mechanics of the execution as an interactive process, the program's products of visual displays and data file output, and potential application of such a tool for analysis of visual activity. 

Gra
training program. In addition, the kinds of NAC training that are most useful to scientists and engineers are identified. The author presented several recommendations to improve the training program at NAC.

GRA

N92-28557# Naval Aerospace Medical Research Lab., Pensacola, FL.


The present study examined the effects of low-intensity argon-laser glare on the visual search performance of aviators. Using a modified backward-masking paradigm, subjects were exposed to laser glare, either while seated in a cockpit simulation trainer with attached F-15 windscreen assembly. Brief exposure to laser glare, either 25 or 50 ms after a visual scene's onset, produced significant decrements in target-detection performance relative to a no-glare control whereas a 300-ms delay of laser glare onset had very little effect. The intensity of the light entering the eye (.38 micro-W/cm²) and producing these effects was far below the Maximum Permissible Exposure (MPE) limit for safe viewing of coherent light. In addition, these effects were modulated by a target's distance from the center of the beam path (also center of the visual display). Specifically, targets closest to the center of the beam path were responded to most slowly and with the least accuracy. This study demonstrated that the presence of the laser glare is not sufficient, in and of itself, to diminish target-detection performance. The time at which laser glare is experienced is an important factor in determining the probability and extent of visually mediated performance decrements. GRA

N92-28744# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.


The U.S. Army Crew Station Research and Development Branch (CSRDB) of the Aircraft Simulation Division (AVSCOM) was tasked by the Light Helicopter Program Manager (LH-PM) to provide training to Army personnel in advanced aircraft simulation technology. The purpose of this training was to prepare different groups of pilots to support and evaluate two contractor simulation efforts during the Demonstration/Validation (DEM/VAL) phase of the LH program. The personnel in the CSRDB developed mission oriented training programs to accomplish the objectives, conduct the programs, and provide guidance to army personnel and support personnel throughout the DEM/VAL phase. Author

N92-28775# Argonne National Lab., IL.


Human error in execution of critical functions and tasks can be costly. The Three Mile Island and the Chernobyl accidents are examples of results from human error in the nuclear industry. There are similar errors that could no doubt be cited from other industries. A strategy to minimize common mode human error in the execution of critical functions and tasks is discussed. The strategy consists of the use of human redundancy, and also diversity in human cognitive behavior: skill-, rule-, and knowledge-based behavior. The authors contend that the use of diversity in human cognitive behavior is possible, and it minimizes common mode error. DOE

N92-28787# Technische Univ., Berlin (Germany, F.R.). Fachbereich Informatik.


The method developed automatically adapts the parameters without unnecessarily raising the computing costs. Known gradient processes are combined with the 'mutation' and 'selection' principles of the strategy of evolution. Prior to each iteration step, a set of learning and strategy parameters is produced by mutation from the present values. A dynamic adaptation is obtained to the constantly changing optimal values of the learning parameters during the learning process. Detailed practical examinations show that the new process strongly reduces the number of necessary learning cycles with regard to other known improvements. ESA

N92-28877# Howard Univ., Washington, DC.


Four kinds of investigations of the structure of high-level visual processing were conducted during the past year. First, we carried out case studies of individual brain-damaged patients, finding evidence that curved edges are processed separately from straight edges, that location information sometimes can be used to encode some characteristics of shape, and that a decrease in overall activation level can selectively impair performance on some tasks. Second, we administered a set of 27 tasks to a group of 17 brain-damaged patients; these tasks were designed to assess the efficacy of specific subsystems. We have preliminary evidence that 70 percent (69 percent of the subsystems double-dissociate, suggesting that these subsystems are in fact distinct. Third, we constructed computer simulation models to explore properties of the high-level visual system, and found support for the distinction between subsystems that compute two distinct kinds of spatial relations. Finally, some of the tasks we had developed to study deficits in brain-damaged patients were used to study the visual-spatial abilities of air force pilots; we found that pilots are particularly good at mental rotation and encoding metric distance information. GRA

N92-28880# California State Univ., Chico. Coll. of Communication.


This study develops a model of instructional design that incorporates the affective domain as an integral component. The model combines Keller's ARCS model of motivation for learning with the five phased military instructional design model. The proposed model provides a framework for organizing instructional principles, strategies and techniques concerning the affective domain and furnishes a theoretical base to aid in formulating research hypotheses and collecting empirical data. Attention to the affective domain is particularly important for technology based
instruction that removes teacher/student interaction from the lesson delivery. This model should be helpful because it provides for the systematic consideration of the affective domain in every aspect of the instructional design process. The study concludes with recommendations for additional research needed to operationalize the model for use by instructional designers. GRA


SCOTT MAKEIG, F. S. ELLIOTT, MARK INLOW, and DAVID KOBUS Jan. 1992 31 p

(AD-A247669; NHRC-92-030) Avail: CASI HC A03/MF A01

Thirteen subjects participated in an auditory simulation of a passive sonor target detection environment. Targets were 300 ms noise bursts presented at near threshold levels in a noise background at a mean rate of 10 per minute. Task irrelevant probe tones were also presented at inter-stimulus intervals of 2-4 seconds. Each subject participated in two 28 minute test sessions, pressing a button whenever they detected a noise target. Prominent minute-scale fluctuations in performance (computed as changes in local error rate using a 32-s moving window) occurred in many of the sessions. Evoked responses to the irrelevant probe tones in thirteen runs with highest number of performance lapses were sorted by current local error rate and smoothed using a moving-average. The amplitude of the grand mean N2 response to the irrelevant probe tones increased monotonically with error rate. Averaged evoked responses to relatively frequent, task-irrelevant probe tones appear to allow an accurate estimate of level of alertness if adequate number of trials are available. GRA


STEVEN W. ZUCKER and MAX S. CYNADER 31 Jan. 1992 12 p

(Contract AF-AFOSR-0260-89) (AD-A247852; AFOSR-92-0211TR) Avail: CASI HC A03/MF A01

To summarize, progress has been made on a family of related problems, including: A model of endstressed visual cortical neurons was extended to include complex components; An extensive simulation of the model was completed with regard to orientation, positional, spatial frequency, curvature, chomor, and end-line sensitivity; Orientation discontinuities were extended into the motion domain, and psychological and computational experiments were performed to confirm the hypothesis of multiple directions being represented at a point of discontinuity; A theory was developed to capture the non-linearities necessary for early measurement of orientation and curvature; A totally different theory has begun to take shape for functionally characterizing cytochrome oxidase blobs; And The mathematical foundations were laid for a theory of shape. GRA


GEORGE J. MIPITOS and SEPPO SOINILA 7 Apr. 1992 71 p

(Contract AF-AFOSR-0262-89) (AD-A250223; AFOSR-92-0299TR) Avail: CASI HC A04/MF A01

We summarize the behavioral, electrophysiological, and immunohistochemical findings in the sea slug, Pleurobrachia, and compare these findings to those obtained in other invertebrate animals, in higher animals, and in humans. The findings show that there is massive distribution and sharing of information occurring, respectively, through diverging and converging network connections. We examine the findings of reductionist approaches and find them inadequate to answer the problems arising from such widely distributed, multifunctional, and highly converging networks whose activity may be variable. Such findings indicate that cooperative actions among groups of neurons may arise dynamically and non-linearly in shifting contexts or consensuses of response in which individual neurons may have different functions, even during times when the behaviors are similar. Control of these systems is emergent, fuzzy, and error-prone rather than being refined or following explicit causes and effects that can be read from the switchboard circuit of the connections between neurons. A unified theoretical perspective is needed that accounts for both the emergent and switch-board systems. Two problems apply in both cases. First, animals may have evolved highly specialized behaviors whose underlying neural networks may not necessarily reflect generally applicable principles. Second, owing to their complexity, it may not be possible to characterize biological networks in sufficient detail to permit an understanding of the system through simulation of the system itself. GRA


(Contract N00014-86-K-0077) (AD-A248728; TR-6) Avail: CASI HC A04/MF A01

Drawing upon the initial research, which has revealed problems among medical students in their understanding of complex material, we propose that new visions of instruction and assessment are required if education is to promote deep and usable understanding of complex, difficult subject matter. In the main, we argue that instruction and testing should be congruent with the cognitive goals for students that are desired--that if what is desired is that students obtain accurate understanding, instruction and testing should focus on this; that if what is desired is that students be able to apply knowledge, instruction and testing should focus on knowledge application; that if what is desired is that students acquire a structure of knowledge that they will not easily forget, education should concentrate on building and assessing robust knowledge structures. We propose some desirable characteristics of learning, teaching and testing for achieving this combination of goals. Tied to this, we suggest that educational goals for understanding can be aided by knowing how understanding is likely to break down, and we present numerous examples of ways that students misunderstand. GRA


WILLIAM A. JOHNSTON, KEVIN J. HAWLEY, and JAMES M. FARNHAM 31 Jan. 1992 44 p

(Contract AF-AFOSR-0275-89) (AD-A250200; AFOSR-92-0306TR) Avail: CASI HC A03/MF A01

Perceptual memory refers to experience-induced changes in perceptual processing of particular objects or scenes. Part 1 of this report summarizes the results of 8 studies of the role of perceptual memory in recognition memory. The hypothesis was confirmed that perceptual memory-contributes to the feeling of familiarity that observers sometimes experience even when they lack explicit memory for previously encountered objects. Part 2 summarizes the results of 14 studies of a by-product of perceptual memory called novel popout. The theory was confirmed that novel popout arises from the automatic disinhibition of processing of objects that fail to match top-down effects of perceptual memory. GRA

N92-29146# Ohio State Univ., Columbus. DEMODULATION PROCESSES IN AUDITORY PERCEPTION Annual Report, 1 Dec. 1989 - 30 Nov. 1990

LAWRENCE L. FETH 1 Mar. 1992 6 p

(Contract AF-AFOSR-0227-89) (AD-A250205; AFOSR-92-0300TR) Avail: CASI HC A02/MF A01
The development of a multi-channel version of the EWAIF model has begun. The revised model is the IWAIF (Intensity Weighted Average of Instantaneous Frequency) model. The intensity is proportional to the square of the amplitude (or envelope) and in an earlier paper the PI had shown that envelope squared weighting worked at least as well as simple envelope weighting. Anantharaman’s work, which he used as his masters thesis, led to a much more efficient calculation scheme. The model helps understand the intuitive notion that a signal’s IWAIF value is its spectral center of gravity. Thus, EWAIF calculations may indeed have application to spectral shape discriminations.

**ACQUISITION AND IMPROVEMENT OF HUMAN MOTOR SKILLS: LEARNING THROUGH OBSERVATION AND PRACTICE**
(NASA-TM-107878; RIA-91-29; NAS 1.15:107878) Avail: CASI HC A02/MF A02

Skilled movement is an integral part of the human existence. A better understanding of motor skills and their development is a prerequisite to the construction of truly flexible intelligent agents. We present MAEANDER, a computational model of human motor behavior, that uniformly addresses both the acquisition of skills through observation and the improvement of skills through practice. MAEANDER consists of a sensory-effector interface, a memory of movements, and a set of performance and learning mechanisms that let it recognize and generate motor skills. The system initially acquires such skills by observing movements performed by another agent and constructing a concept hierarchy. Given a stored motor skill in memory, MAEANDER will cause an effector to behave appropriately. All learning involves changing the hierarchical memory of skill concepts to more closely correspond to either observed experience or to desired behaviors. We evaluated MAEANDER empirically with respect to how well it acquires and improves both artificial movement types and handwritten script letters from the alphabet. We also evaluate MAEANDER as a psychological model by comparing its behavior to robust phenomena in humans and by considering the richness of the predictions it makes.

**VISUAL PERCEPTION OF ELEVATION**

**53 BEHAVIORAL SCIENCES**

**FOUR-CHANNEL VERSION OF THE EWAIF MODEL:**

**Pennsylvania Univ., Philadelphia.**

**BIOLOGICALLY-BASED NEURAL NETWORK MODEL OF COLOR CONSTANCY AND COLOR CONTRAST:**


The light which reaches the eye, or any other sensor, is the product of the reflectance and the illuminant. Therefore, in order to determine the surface reflectance of an object independently of the illuminant, a system must use the spatiochromatic context of the image. We have developed a neural network based on the anatomy and physiology of the visual projection from retina to V4. The network combines color-opponent and contrast information to achieve a good degree of color constancy. This network was tested on simulated images corresponding to the stimuli used in well established psychophysiological experiments. Responses qualitatively match human responses to a variety of center-surround and Mondrian test stimuli. Color constancy is the ability to maintain an approximately constant color perception despite changes in the incident illumination of the object. Color contrast, also referred to as chromatic induction or simultaneous contrast, is the change in the (perceived) color of a surface due to the spectral composition of neighboring surface. Color perception in natural scenes depends upon both of these phenomena. Together, these two effects demonstrate that color perception does not directly depend upon the wavelength of the light reflected from a surface.

**A SYSTEMS THEORETIC INVESTIGATION OF NEUROANAL NETWORK PROPERTIES OF THE HIPPOCAMPAL FORMATION**

**Columbia Univ., New York, NY.**


The experiments demonstrate the importance for human observers of the retinal orientation and location of individual straight lines in determining (1) the physical elevation visually perceived as being at eye level (VPEL), and (2) the orientation within a frontal plane visually perceived as being vertical (VPV). The particular depth plane is unimportant for each discrimination as shown by experiments in which stimuli at the same retinal location from differently pitched and differently rolled planes of different depth influence each discrimination identically. The laws of spatial summation for lines controlling VPEL have been determined and are very different than for other visual discriminations: Influences for a parallel line set summate across a negatively accelerated exponential with a 15.1 degree space constant; lines from nonparallel sets make use of a mechanism that takes a weighted average of their individual influences. The time course for light and dark adaptation of VPEL for a 2-line stimulus is similar to that for a normally illuminated and fully structured pitched visual environment. The VPEL discrimination is near-spatiotopic for eye position and head orientation. The analysis of results at 1.5G has not yet been completed, but it appears that a bias with only minimal influence on the slope of the VPEL vs-pitch function results from change of G.
which only the M or L cones could detect the interference fringe. Visual acuity was little different than it was when both cone types the living eye, clarifying the relationship between cone spacing visual pathway. The appearance of very high frequency interference surprisingly little across the visual field. In addition, we have taken provide objective measurements of the off-axis optical quality of understood, and that it is chromatic aliasing caused by spatial established that a phenomenon known for 150 years has been misunderstood, and that it is chromatic aliasing caused by spatial and mechanisms whereby individual stimulus components combine to influence the detection and discrimination of complex sounds. The project is designed to answer specific questions regarding listeners' abilities to integrate information within and across acoustic dimensions, to extract information contained in the pattern of the acoustic signal, and to perform under conditions of stimulus uncertainty. The data are also used to determine how listeners weight the information provided by different components of the signal, and how best to package the acoustic information so as to be most effectively processed by the listener.

In order to discriminate objects in the visual world, the nervous system must solve two fundamental problems: binding and segmentation. The binding problem addresses how the attributes of an object’s shape, color, motion, and depth are linked to create an individual object. Segmentation deals with the converse problem of how separate objects are distinguished.

This project employs psychophysical techniques to examine the limitations on spatial vision imposed by the first stages in the visual pathway. The appearance of very high frequency interference fringes is distorted, or aliased, by the cone mosaic. Such moire patterns allow us to assess the topography of the cone mosaic in the living eye, clarifying the relationship between cone spacing and resolution. Resolved was also measured under conditions in which only the M or L cones could detect the interference fringe. Visual acuity was little different than it was when both cone types detected the grating showing that resolution is immune to photoreceptor loss under these circumstances. We recently also established that a phenomenon known for 150 years has been misunderstood, and that it is chromatic aliasing caused by spatial sampling by M and L cones. A device has been constructed to provide objective measurements of the off-axis optical quality of the eye, and measurements show that optical quality declines surprisingly little across the visual field. In addition, we have taken advantage of an early nonlinearity in the visual system to measure the spatial responses of the earliest stages in retinal processing.
on the required live training effect is not a simple matter to assess. Any such deduction should be thoroughly evaluated to guarantee operational safety and effectiveness.

ES A

N92-29930# Princeton Univ., NJ.
(AD-A248334; REPT-255-6491-1; AFOSR-92-0189TR) Avail: CASI HC A01/MF A01

These experiments are directed at the neurochemical systems and neuroanatomical pathways that control the activity of brain serotonergic (dorsal raphe nucleus) and noradrenergic (locus coeruleus) neurons. It seeks to answer these questions by studying single unit activity in combination with microiontophoresis in the awake cat during exposure to physiologically relevant conditions. Four series of studies are proposed. The first three will examine the neurochemical afferents that control the following types of activity of serotonergic and noradrenergic neurons: (1) tonic, as well as state-dependent activity, (2) phasic activity evoked by various sensory stimuli, and (3) activation in response to environmental and physiological challenges (stressors). The fourth series of studies will take results from the first three and seek to establish the nuclear site of origin of these effects by employing electrical stimulation in combination with single unit recording and microiontophoresis. This research program will provide a critical link for understanding the control of these two important neurochemical systems, and will thus help to elucidate, more broadly, their role in processes such as state-dependent changes in physiology and behavior, and arousal and attention. G R A

N92-30127# Federal Aviation Administration, Washington, DC.
REVISION OF CERTIFICATION STANDARDS FOR AVIATION MAINTENANCE PERSONNEL

Part 65, Subparts D and E, of the Federal Aviation Regulations (FAR) identify the certification requirements for aviation mechanics and aviation repairmen. The training, experience, privileges, ratings, recordkeeping, and currency requirements for aviation maintenance personnel are also addressed by those parts of the FAR. The recent emergence of the aging fleet problem and the introduction of new technologies, aircraft, engines, and aeronautical products has caused certain portions of these rules to become obsolete. Further, international political arrangements, such as bilateral airworthiness and maintenance agreements, International Civil Aviation Organization (ICAO) standards, certain international agreements for maintenance personnel training, and mechanic certificate reciprocity, have all impacted on the current regulatory policy.

Author

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A92-44905# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFORMATION MANAGEMENT FOR COMMERCIAL AVIATION - A RESEARCH PERSPECTIVE
WENDELL R. RICKS, KATHY H. ABBOTT (NASA, Langley Research Center, Hampton, VA), JON E. JONSSON (Douglas Aircraft Co., Long Beach, CA), GEORGE BOUCEK (Boeing Commercial Airplane Group, Seattle, WA), AND WILLIAM H. ROGERS (Boeing

The problem of flight deck information management (IM), defined as processing, controlling, and directing information, for commercial flight decks, and a research effort underway to address this problem, are discussed. The premises provided are utilized to lay the groundwork required for such research by providing a framework to describe IM problems and an avenue to follow when investigating solution concepts. The research issues presented serve to identify specific questions necessary to achieve a better understanding of the IM problem, and to provide assessments of the relative merit of various solution concepts. R.E.P.

A92-44906# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFORMATION MANAGEMENT - ASSESSING THE DEMAND FOR INFORMATION
WILLIAM H. ROGERS (Boeing

Information demand is defined in terms of both information content (what information) and form (when, how, and where it is needed). Providing the information richness required for flight crews to be informed without overwhelming their information processing capabilities will require a great deal of automated intelligence. It is seen that the essence of this intelligence is comprehending and capturing the demand for information. R.E.P.

A92-44908# FLIGHT DECK INFORMATION MANAGEMENT - A CHALLENGE TO COMMERCIAL TRANSPORT AVIATION

Some operational flight deck information management examples are presented and aviation industry and research needs in this area are defined. Flight deck information overload has been a concern for a number of years as has the integration of information from various sources and media. The goal should be to adopt a human-centered information system design approach (Rouse, 1990), through which the operator's information processing and usage requirements are completely taken into account. R.E.P.

A92-44910# AUTOMATIC DISPLAY MANAGEMENT USING DYNAMIC PLANS AND EVENTS

A flexible and powerful approach to automatic management of computer-based displays and controls has been developed as a part of the Intelligent Pilot Vehicle Interface (PVI) for the USAF/Lockheed Pilot's Associate. Because the active information requirements are maintained dynamically as the system is operated, the automatic selection of display formats and control functions can be sensitive to the exact tasks and situations of the pilot. The generality of the display management process suggests that it can be easily applied in a wide variety of situations in which management of large volumes of time-sensitive information is an issue for effective system operation. Author

A92-44913# INTERFACE STYLES FOR ADAPTIVE AUTOMATION

Vol. 1. Columbus, OH, Ohio State University, 1991, p. 90-95. refs

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A92-44910# AUTOMATIC DISPLAY MANAGEMENT USING DYNAMIC PLANS AND EVENTS
A92-44914
THE EFFECT OF ADAPTIVE FUNCTION ALLOCATION ON THE COCKPIT DESIGN PARADIGM

It is noted that some of the adverse effects of automation in cockpit design may be reduced if adaptive rather than static automation is employed. Adaptive automation is implemented dynamically in response to altering task demands. The design of a direct manipulation interface (Jacob, 1989) that should offset some of automation's drawbacks is discussed. R.E.P.

A92-44918* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.
AN EVALUATION OF FLIGHT PATH MANAGEMENT AUTOMATION IN TRANSPORT CATEGORY AIRCRAFT

A desk-top simulation of a Boeing 757/767 Electronic Flight Instrumentation System (EFIS) and Control Display Unit (CDU) was used in an experiment to compare three modes of communication for the clearance amendment process: standard voice (SV), probed textual delivery method, and a graphical delivery method. Eight qualified Boeing 757/767 pilots served as subjects. Each flew nine landing scenarios with three amendments given in each scenario. Both acceptable and unacceptable clearance amendments were presented in order to assess situational awareness. Times for comprehension and execution of the amendment were recorded along with workload ratings, responses to unacceptable amendments, and subjective impressions. The graphical mode was found to be superior in terms of the time measures and subjective ratings. No difference was found between the modes in the ability to detect unacceptable clearances.

A92-44928* Coding Techniques for Rapid Communication Displays

A critical issue for the successful application of rapid communication (RAPCOM) display technology lies in whether or not the information presented can be portrayed so that successive frames can be independently discriminated by the user. This study compared performance on a monitoring task for four single coding strategies as well as four redundant code combinations at four presentation rates. Results indicated significant differences in accuracy and reaction time for task performance using single and redundant codes at various frame durations. These findings represent a step toward defining efficient coding formats for future applications of RAPCOM technology in operational settings.
CUSTOMIZING THE ATC COMPUTER-HUMAN INTERFACE VIA THE USE OF CONTROLLER PREFERENCE SETS

ATTENTIONAL ISSUES IN SUPERIMPOSED FLIGHT SYMBOLOLOGY
D. C. FOYLE (NASA, Ames Research Center, Moffett Field, CA), B. D. SANFORD (San Jose State University, CA), and R. S. MCCANN (Sterling Federal Systems, Inc.; NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1, Columbus, OH, Ohio State University, 1991, p. 577-582. refs

AN OVERVIEW OF HUMAN FACTORS R&D IN FLIGHTDECK AUTOMATION - THE NATIONAL PLAN FOR AVIATION HUMAN FACTORS

A USEFULNESS OF SIMULATION IN HUMAN FACTORS TEST AND EVALUATION OF THE LH HELICOPtER

THE USE OF SIMULATION IN FLIGHT - IS IT INFORMATION OR ISN'T IT?

DIVERTER - PERSPECTIVES ON THE INTEGRATION AND DISPLAY OF FLIGHT CRITICAL INFORMATION USING AN EXPERT SYSTEM AND MENU-DRIVEN DISPLAYS
An expert system prototype, called Diverter, was developed which evaluates, integrates, and displays flight plan recommendations to the pilot during the planning of an inflight diversion. The system integrates information from many sources to provide a comprehensive description of the flight planning alternatives available to the pilot. Diverter evaluates all applicable constraints to arrive at a flight plan to make efficient use of manpower, fuel, and time. The use of an expert system automates much of the integration and evaluation of variables impacting the flight. The use of hierarchical menu-driven displays and direct manipulation interface techniques may reduce workload. Author

A92-45036
RESEARCH IN COOPERATIVE PROBLEM-SOLVING SYSTEMS FOR AVIATION
C. E. Mccoy (nebraska, University, Omaha), Philip J. Smith, and Chuck Layton (ohio State University, Columbus) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 899-903. Refs

A three-stage process for the design of cooperative, en route flight-planning systems is presented which involves human-performance modeling in existing environments, followed by the construction of cognitive artifacts and the study of subjects working in collaboration with these artifacts. Attention is given to the prototyping environment thus far developed within this process-framework; this functional system has proved to be a valuable aid in the stimulation of novel concepts and their appraisal, as well as an efficient basis for the collection of empirical data on which evaluations can be based. O.C.

A92-45040
INTERACTIVE VIDEO DISK AS AN INSTRUCTIONAL TOOL IN CRM PROGRAMS

The present discussion of SAC's Crew Resource Management (CRM) program gives attention to the use of the Interactive Video Disk (IVD) device as an effective instructional tool. The use of IVD allows the videotaped scenarios to be specific not only to a given aircraft, but also to the mission question. Because IVD is a dynamic medium, the CRM student interacts with the program through responses to questions and video sequences. IVD programs also allow training interruptions when necessary, with subsequent resumption from the point at which the student left off. O.C.

A92-45047
KNOWLEDGE TRANSFER AND SUPPORT SYSTEMS IN FIGHTER AIRCRAFT

Pilot conversion from one aircraft to another with different technology is a process in which knowledge-transfer is as critical a factor as knowledge-acquisition. While transfer may for the pilot in question be positive in terms of 'cognitive cost', it could also be negative for safety and/or efficiency. This apparent conflict in purposes entails a cautionous attitude toward the stipulation of inviolable rules concerning transferred knowledge, every context for transplantation must be ergonomically analyzed, in order to improve and more clearly define the learning process. O.C.

A92-45051
COCKPIT DESIGN CONSIDERATION FOR HIGHLY AGILE AIRCRAFT

A MIL-STD HUD symbology is proposed which attempts to empower pilots of prospective ultramanueverable aircraft with the fullest accessibility to such expanded flight envelopes. Attention is given to this HUD's innovative pitch/flight path angle scale, ghost horizon, and climb/dive marker. More advanced cockpit-display formats, such as 'pathway-in-the-sky', are under development for the longer term and may be applicable to NASA's High Speed Civil Transport. An evaluation is made of the various, distinctive functional advantages of the proposed symbols. O.C.

A92-45056
COMPATIBILITY AND CONSISTENCY IN AIRCREW DECISION AIDING

A group of 32 subjects performed a flight-control task while responding to between one and four analog indicators that were formatted as either command or status-decision aid displays. The results obtained indicate the advantage of the status format when subjects are required to verbally support the state of the indicator(s), in part, because the command format 'bypasses' the representation of the indicator's state from which the command was derived. No advantage is noted for either format in the case where the subjects are required to manually correct the state indicated. The importance of consistency in system-design efforts may exceed that of compatibility. O.C.

A92-45062
INVESTIGATION AND EVALUATION OF A COMPUTER PROGRAM TO MINIMIZE VFR FLIGHT PLANNING ERRORS

The purpose of this study was to investigate the effect of computer aided flight planning on flight planning errors. Focus was on two variables: pilot cross country flight experience and prior computer experience. It was initially expected that the computer aided flight plans would have fewer flight planning errors than those calculated using conventional methods. The results obtained by analyzing the two variables supported the hypothesis that flight planning errors are greatly reduced when computer aided flight planning techniques are used.

A92-45250
AN ARGUMENT FOR HUMAN EXPLORATION OF THE MOON AND MARS

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The merits of human space missions and the role of people in the scientific exploration of space are examined with particular reference to the Space Exploration Initiative. It is noted that certain tasks, such as custom installation of complex and delicate scientific instruments and various repair and maintenance operations, can be best accomplished by human operators and that reliance on robots only would limit the mission capabilities. Consideration is also given to the importance of field work by scientists in space exploration, the concept of telepresence, and the need for closer collaboration between robots and people. V.l.
CONTACT LENS WEAR WITH THE USAF PROTECTIVE INTEGRATED HOOD/MASK CHEMICAL DEFENSE ENSEMBLE

RICHARD J. DENNIS, ROBERT E. MILLER, II, RIC D. PETERSON, and WILLIAM J. JACKSON, JR. (U.S. Army, School of Aviation Medicine, Fort Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 7, July 1992, p. 556-571. refs Copyright

The Protective Integrated Hood/Mask (PIHM) chemical defense aircrew ensemble blows air from the mask’s plenum across the visor at a rate of approximately 15 L/min in order to prevent fogging of the visor and to cool the aircrew member’s face. This study was designed to determine the effect of the PIHM airflow on soft contact lens (SCL) dehydration, contact lens comfort, and corneal integrity. There were 28 subjects who participated in this study: 15 SCL wearers, six rigid gas-permeable (RGP) wearers, and five nonspectacle wearing controls. Contrast acuity with the three Regan charts, subjective comfort, and relative humidity (RH) and temperature readings under the PIHM mask were monitored every 0.5 h during 6-h laboratory rides. Slit-lamp examinations and SCL water content measurements with a hand-held Abbe refractometer were made before and after the rides. High RH under the mask may have accounted for the moderate SCL dehydration (8.3 percent), no decrease in contrast acuity for any group, and lack of corneal stress. Although all groups experienced some inferior, epithelial, punctate keratopathy, RGP wearers had the most significant effects. SCLs performed relatively well in the PIHM mask environment. Testing with other parameter designs is necessary before recommending RGPs with the PIHM system. 

AN EXTENSION OF HUMAN OPTIMAL CONTROL MODEL

SHU-MING LUO (Institute of Space Medico-Engineering, Beijing, People’s Republic of China) Space Medicine & Medical Engineering (ISSN 1002-0837), vol. 5, no. 1, 1992, p. 31-36. In Chinese. refs

The mathematical model of human optimal control (Kleinman, 1981) is extended using the modern control theory. The applicability of the extended model is tested using three types each of specially designed dynamics and control tasks. Comparisons of results obtained from manual control compensatory tracking experiments with the results obtained on manual-control man-machine systems simulated by the extended human optimal control model showed excellent agreement.
BIG GRAPHICAL DISPLAYS FOR MAINTENANCE TASKS


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The design of computer-based graphical displays for maintenance tasks is addressed. Traditional maintenance information includes large graphical drawings that are difficult to portray on the small screens of computer-based maintenance information systems. This research investigates the design of graphical displays using display abstraction and aggregation as design parameters. A display's aggregation level reflects the field of view of a display, such as component, assembly, or system level diagrams. A display's abstraction level reflects the representation contained in a diagram, such as a component's form, function, or purpose in an assembly. The results from two experiments with experienced maintenance personnel are presented. Results of this investigation suggest promise for the application of these concepts to the development of computer-based maintenance information systems.

MINIMUM AUDIBLE MOVEMENT ANGLE AS A FUNCTION OF THE AZIMUTH AND ELEVATION OF THE SOURCE

THOMAS Z. STRYBEL (California State University, Long Beach), CAROL L. MANLIGAS, and DAVID R. PERROTT (California State University, Los Angeles). Human Factors (ISSN 0018-7208), vol. 34, no. 3, June 1992, p. 267-275. refs (Contract NSF BNS-90-25118; NIH-3505-RR-0801-1452)

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Auditory directional cues to enhance situational awareness in cockpits with head-coupled displays are examined in terms of the pilot's ability to detect the direction of moving sounds at different locations in space. Auditory motion acuity was measured by the minimum audible movement angle (MAMA) which is the minimum angle of travel required for detection of the direction of sound movement. Five experienced listeners were instructed to indicate the direction of travel of a sound source (broadband noise at 50 dBA) that moved at a velocity of 20 deg/s. Nine azimuth positions were tested at 0 deg elevation. Five elevations were then tested at 0 deg azimuth. Finally, two azimuth positions were tested at an elevation of 80 deg. The position of the source did not significantly affect the MAMA for azimuth locations between 70 and 90 deg and elevations below 80 deg. Within this area the MAMA ranged from 1 deg to 2 deg. Outside this area the MAMA increased to 3 to 10 deg.

APPARENT SIZE AND DISTANCE IN AN IMAGING DISPLAY

JAMES W. MEEHAN (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France) and THOMAS J. TRIGGS (Monash University, Melbourne, Australia). Human Factors (ISSN 0018-7208), vol. 34, no. 3, June 1992, p. 303-311. refs

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The size-distance invariance hypothesis suggests that the perceived size and the perceived distance of objects in a field viewed naturally are closely related. However, this relationship breaks down when scenes are viewed through high-power optical systems. When natural scenes are viewed through an imaging display of unity magnification, there is a reduction in their apparent size. This raises the question of whether the relationship breaks down when scenes are viewed through a low-power imaging display. A single-lens reflex camera was used as an imaging display that enabled subjects to vary the size of images real-world scenes. Judgments of size were found to vary with depth information in scenes and between monococular and binocular viewing, consistent with a previous finding, but judgments of distance did not vary significantly across either of these conditions. The results suggest that judgments of size and judgments of distance with the imaging displays are not influenced uniformly by environmental and task variables.
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Human Factors (ISSN 0018-7208), vol. 34, no. 3, June 1992, p. 313-334. refs
(Copyright N.S.E.C.-A-8351)

Subjects judged change and proportion when viewing graphs in two experiments. Change was judged more quickly and accurately with line and bar graphs than with pie charts or tiered bar graphs, and this difference was larger when the rate of change was smaller. Without a graduated scale, proportion was judged more quickly and accurately with pie charts and divided bar graphs than with line or bar graphs. Proportion is direct when it requires simpler or fewer mental operations; it is proposed that perception of change is direct with line and bar graphs, whereas perception of proportion is direct with pie charts and divided bar graphs. The results are also consistent with the proximity compatibility principle. Suggestions for improving the design of graphical displays are given.

A92-46763 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MAN-IN-THE-LOOP STUDY OF FILTERING IN AIRBORNE HEAD TRACKING TASKS
S. LIFSHITZ and S. J. MERHAV (Technion - Israel Institute of Technology, Haifa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 4, July-Aug. 1992, p. 1043-1045. Research supported by NASA. refs
(Contract NAGW-1128; AF-AFOSR-88-0298)

Copyright

A human-factors study is conducted of problems due to vibrations during the use of a helmet-mounted display (HMD) in tracking tasks whose major factors are target motion and head vibration. A method is proposed for improving aiming accuracy in such tracking tasks on the basis of (1) head-motion measurement and (2) the shifting of the reticle in the HMD in ways that inhibit much of the involuntary apparent motion of the reticle, relative to the target, and the nonvoluntary motion of the teleoperated device. The HMD inherently furnishes the visual feedback required by this scheme.

O.G.

A92-46795 RANGE, ENERGY, HEAT OF MOTION IN THE MODIFIED NBC, ANTI-G, TANK SUIT
JOSEPH A. MASTROPAOLO (Trisphere Institute of Sports Medicine, Huntington Beach, CA), A. N. DE GASTON, CRAIG H. DUPCK (McDonnell Douglas Corp., Long Beach, CA), and ALLEN R. VAN SANTEN (Trisphere Institute of Sports Medicine, Huntington Beach, CA) Journal of Aircraft (ISSN 0003-0589), vol. 29, no. 4, July-Aug. 1992, p. 652-656. refs
Copyright

The modified nuclear, biologic pathogen, chemical (NBC), anti-g, and anthropomorphic tank suit (ATS 2), was designed and modified. The ATS 2 provided a protective liner of water around, but not in contact with, the subject to the neck. For three subjects in the ATS 2, range of motion was lost in 30 of 32 tests by an average of 39 percent dry and 40 percent wet, p less than 0.001. For work rates from 49 to 151 W, all blood pressures were significantly elevated, p less than 0.05, but no other significant differences were found. The factors dry and wet, for heart rate were 1.2, 1.3; for systolic blood pressure 1.2, 1.4; for diastolic blood pressure 1.1, 1.3; for estimated mean blood pressure 1.1, 1.3; for ventilation 1.7, 2.0 and for energy of motion 1.40, 1.53. The factor 1.53 was an underestimation because of a suppressed maximal oxygen consumption. Special joints, pressure breathing and water cooling seemed desirable for future suits.

A92-47682 COCA-COLA SPACE CAN UNDERGOES SUCCESSFUL TEST BY COSMONAUTS ONBOARD SOVIET SPACE STATION MIR
AIAA Student Journal (ISSN 0001-1460), vol. 29, no. 4, Winter 1992, p. 14, 15. Copyright

The Coca-Cola space can has been successfully tested onboard the space station Mir in August 1992 by the Coca-Cola Company in cooperation with the Energia Soviet space agency. The test demonstrated the can's ability to provide carbonated soft drinks for consumption by cosmonauts in the microgravity environment.

O.G.

A92-48174* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

WASTE STREAMS IN A CREWED SPACE HABITAT. II
Copyright

An update is presented of a compilation of generation rates and chemical compositions of potential waste streams in a typical crewed space habitat which was reported in the NASA Technical Memorandum. New topics under consideration include data obtained from Soviet literature on life support issues and data on various minor human body wastes not presented previously (saliva, Flatus, hair, finger- and toenails, dried skin and skin secretions, tears and semen). Attention is also given to the latest information on the environmental control and life support system design parameters for SSF.

O.G.

A92-48395* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

UTILIZATION OF POTATOES FOR LIFE SUPPORT SYSTEMS IN SPACE. I - CULTIVAR-PHOTOPERIOD INTERACTIONS
RAYMOND M. WHEELER and THEODORE W. TIBBITTS (Wisconsin, University, Madison) American Potato Journal (ISSN 0003-0589), vol. 63, 1986, p. 315-323. Research supported by University of Wisconsin. refs
(Contract NCC2-136; NCC2-301)

Copyright

The productive potential of four potato varieties considered as a food source for space stations and/or lunar colonies was assessed for plants grown for 15 weeks in walk-in rooms at 20 C under 12-, 16-, or 20-hr exposures to 400 micromol/sq m per sec photosynthetic photon flux. It was found that Norland potatoes yielded the greatest tuber fresh weight, producing 2.3, 2.4, and 2.9 kg/plant under 12-, 16, and 20-hr, respectively. The respective yields for the other three varieties were: Superior, 1.9, 1.5, and 1.8 kg/plant; Norchip, 1.8, 1.4, and 2.0 kg/plant; and Kennebec, 2.3, 0.2, and 0.8 kg/plant.

I.S.

A92-48396* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

UTILIZATION OF POTATOES FOR LIFE SUPPORT SYSTEMS. II - THE EFFECTS OF TEMPERATURE UNDER 24-H AND 12-H PHOTOPIERIODS
RAYMOND M. WHEELER, KENNETH L. STEFFEN, THEODORE W. TIBBITTS, and JUINAN P. PALTA (Wisconsin, University, Madison) American Potato Journal (ISSN 0003-0589), vol. 63, 1986, p. 639-647. Research supported by University of Wisconsin. refs
(Contract NCC2-136; NCC2-301)

Copyright

The effects of temperature and the photoperiod length on the growth and tuberization of Norland potatoes were investigated for two photoperiods, 12-h and 24-hr at 400 micromol/sq m per sec PPF, and at temperatures of 12, 16, 20, 24, and 28 C. It was found that stem length increased with increasing temperature under both photoperiods. The highest tuber yield was obtained at 16 C under the 24-hr photoperiod and at 20 C under the 12-hr photoperiod (i.e., increasing the photoperiod from 12 to 24 hrs effectively decreases the optimal temperature for tuber formation). Little or no tuber formation occurred at 28 C under either photoperiod.

I.S.

A92-48397* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

UTILIZATION OF POTATOES FOR LIFE SUPPORT SYSTEMS IN SPACE. III - PRODUCTIVITY AT SUCCESSIVE HARVEST DATES UNDER 12-H AND 24-H PHOTOPIERIODS

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RAYMOND M. WHEELER and THEODORE W. TIBBITTS (Wisconsin, University, Madison) American Potato Journal (ISSN 0003-0589), vol. 66, 1989, p. 25-34. Research supported by University of Wisconsin. refs

A92-48398* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

UTILIZATION OF POTATOES FOR LIFE SUPPORT SYSTEMS IN SPACE. IV - EFFECT OF CO2 ENRICHMENT RAYMOND M. WHEELER (Bionetics Corp., Cocoa Beach, FL) and THEODORE W. TIBBITTS (Wisconsin, University, Madison) American Potato Journal (ISSN 0003-0589), vol. 66, 1989, p. 25-34. Research supported by University of Wisconsin. refs


The approved DoD Instruction (DoDI) 5000.2, Defense Acquisition Management Policy and Procedures, and draft AFR 57-1, Operational Needs, Requirements, and Concepts, require Manpower, Personnel, Training, and Safety (MPTS) or Human Systems Integration (HSI) analysis early in the acquisition process. These new requirements push MPTS analysis earlier than ever before into the pre-concept and concept phases. Air Force (AF) and DoD acquisition leaders have been stressing the importance of higher quality system requirements identification and refinement prior to entering the demonstration/validation phase, since it is less expensive to make conceptual changes than engineering changes during the later acquisition phases. The authors examine one method by which AF personnel and contractors can conduct early MPTS/HSI analysis with today's available MPTS tools and databases.

I.E.
A methodology for designing a closed-loop motion simulation is discussed. This procedure is applicable to a centrifuge simulator as well as other types of devices which can produce both motion and visual fields. The key issues of coordinating the motion field with the visual simulation are discussed. Both systems are driven by the stick commands of the pilot, thus making it closed loop. The motion fields simulated are based on supermaneuvarable flight trajectories where research is needed to investigate how these supermaneuvers influence the ability of a pilot to perform a mission. It has been shown in performance studies that an agile aircraft has a definite combat edge over a nonagile aircraft. Also, using agility, a tactical maneuver can be performed expending less overall aircraft energy.

**A92-48537**

**THE USE OF A TACTILE DEVICE TO MEASURE AN ILLUSION**


A device known as the Tactile Perceived Attitude Transducer (TPAT) has been fabricated which makes use of the subject's hand and forearm to describe perceived attitude. The first experiment involving the use of the TPAT was an attempt to quantify the G-excess effect. This effect is the basis for a pilot illusion that can cause overbanking of an aircraft. The G-excess illusion is an exaggerated sensation of body tilt caused by a greater than 1 Gz acceleration on the otolith organs of the vestibular system. The experimental design includes several tests of the TPAT as a cross modal measurement technique. The use of the TPAT in this experiment has resulted in an expanded and progressive experimental design which is considerably larger and more complex than a typical experiment on the DES (Dynamic Environment Simulator). However, the design provides a unique opportunity to carefully examine the cross modal matching of two metrics involved in a complex blending of the visual and vestibular systems.

**A92-48538**

**THE CASE FOR RECURRENT TRAINING ON HUMAN CENTRIFUGES**


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Anecdotal evidence and some evidence from both animal and human experimentation indicate that there is a steady decline in G tolerance when exposures to sustained acceleration are lacking or infrequent. Likewise, there is evidence that frequent exposure enhances G tolerance. The author examines some arguments for recurrent centrifuge training of aircrew personnel for the maintenance and enhancement of sustained acceleration tolerance.

**A92-48541**

**3-D TV WITHOUT GLASSES**


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The author describes a hologram-like 3-D high-resolution color CRT (cathode ray tube)-based stereoscopic television-like video display technique that is presently under development. The patented technique used is unique in that it is autostereoscopic, i.e., no special glasses, goggles, panels, helmets or two-channel optical systems are required by the viewer to see depth. Any image that can be put into a television-like format can be displayed. This allows real-time computer-generated shaded surfaces and real-time scanning sensor data to be viewed with depth in a format familiar to the viewer.

**A92-48544**

**SPECIFYING PERFORMANCE FOR A NEW GENERATION OF VISIONICS SIMULATORS**


Copyright

It is noted that the specifics of visual systems, and related visionics systems, is one of the most difficult aspects of flight trainer procurement. The common goal for the services and industry is to establish specification terms which ensure the most cost-effective training systems. There has been a shift in specifications from terms of graphics primitives, such as polygons and lights, to terms of training cues, such as terrain fidelity. The authors describe the impact of this new specification method for three key areas of visionics system performance: terrain fidelity, feature fidelity, and system resolution.

**A92-48545**

**LOW-COST APPROACHES TO VIRTUAL FLIGHT SIMULATION**


Copyright

An attempt was made to determine whether a flight simulator could be hosted on inexpensive computer image generators (CIG) and interfaced to a virtual environment system. Effective training systems provide a wide visual field-of-view through the use of CRT (cathode ray tube) arrays or dome simulator projectors. These display systems require graphics processing support from expensive CIGs with multiple graphics channels. A promising technology that could help reduce the costs of these flight simulators is head-mounted display (HMD) systems. Simple virtual world interfaces using HMD technology require only one graphics channel, providing the potential to use low-cost CIGs. The approach was to build a virtual world interface to an existing flight simulator application using an HMD. To investigate two classes of computing platforms suitable for use as the CIG, the flight simulator was hosted on a Silicon Graphics Iris 4D/85GT and an 80386/80387 enhanced with a high-performance graphics engine. Neither the SGI 4D/85GT system nor the PC system achieved the desired frame rate; however, the performance of the SGI 4D/320VX did show that a more powerful workstation could.

**A92-48546**

**EMBEDDING TRAINING IN A SYSTEM**


Copyright

A review was conducted of US Air Force, Army, and Navy studies which attempted to establish procedures and guidelines for the development of embedded training (ET). The review showed that studies to date have not provided an analysis process which can examine early design data, and state with any precision what ET is required and what its content should be. Based on this review and some internal company research, characteristics required of a process to determine and specify ET were developed.
A conceptual procedure for conducting the analysis of ET requirements is presented. This procedure incorporates procedures from recent Army and Navy published studies. The conclusion is that, by combining the procedures from these endeavors, a process can be demonstrated which will define ET requirements early enough to include in system design.

A92-48547
A REMOTE VISUAL INTERFACE TOOL FOR SIMULATION CONTROL AND DISPLAY

The authors discuss the design and development of the Visual Interactive Simulation Interface Tool (VISIT). VISIT was designed to provide the graphical representation and user interface for a simulation that is running on another processor utilizing internet communications. Since the simulation processor may be any system capable of implementing the proper network protocol, specialized processors with no graphics display devices can benefit from this architecture. The system provides support for various input devices to control the simulation display and environment. Simulation objects are displayed using either a 3-D wireframe representation or a Gouraud shaded representation. Viewer interaction with the simulation is provided by a collection of commands that allow the viewer to initialize, start, stop, and restart the simulation. The viewer also has the ability to establish checkpoints. Upon reaching a checkpoint the viewer can step through the output display and/or manipulate the objects within the simulation.

A92-49073#
PURIFICATION AND STORAGE OF WASTE GASES ON SPACE STATION FREEDOM

Fluid systems are being designed to handle waste gases generated from experiments performed on Space Station Freedom. These laboratory waste gases are collected and stored for later use as supplemental boost propellant for a resistojet propulsion system. Contained within waste gases will be contaminants, including organic and inorganic acids and bases, solvents, halogens, and material particulates. Concentrations and mixtures of gases and contaminants will constantly change over the 30-year operation of the Station. Material selection for system components must consider corrosion and stress corrosion cracking. This paper describes the difficulties associated with characterizing material behavior for fluid system designs in such an unpredictable gas environment. Material selection and design of high pressure (1100 psi) storage tanks are considered. Composite pressure vessels, with nickel alloy liners that operate in a residual compressive stress state up to maximum operating pressure, are discussed as a method of eliminating stress corrosion cracking concerns. Also presented are data on a prototype gas purifier, which can minimize waste gas contaminant levels prior to storage.

A STUDY OF PILOT ATTITUDES REGARDING THE IMPACT ON MISSION EFFECTIVENESS OF USING NEW COCKPIT AUTOMATION TECHNOLOGIES TO REPLACE THE NAVIGATOR/WEAPON SYSTEM OFFICER/ELECTRONIC WARFARE OFFICER M.S. Thesis
WILLIAM K. STARR and DONALD A. WELCH Sep. 1991 258p

This study analyzed the self-reported survey responses of 404 Air Force pilots concerning their perceptions of using advanced cockpit technologies to replace the Navigator, Weapon System Officer, and Electronic Warfare Officer (Nav/WSO/EWO) and the impact of advanced cockpit technologies on combat mission effectiveness. The first objective of this study was to compare, by aircraft type, the mission effectiveness factors that are always critical and almost always critical to the success of a combat mission. The second objective was to examine, from the pilot's point of view, the Nav/WSO/EWO's contribution (NAVCRIT) to enhancing the combat mission effectiveness factors. The third objective was to examine the Nav/WSO/EWO's contribution (REQ) to overall combat mission success. A stepwise regression model for predicting NAVCRIT and REQ utilizing surveyed pilot demographics was also explored. Research conclusions were mixed, since aircraft type impacted on almost all results. Mission effectiveness factors that were always critical were, however, similar across all aircraft types. Examination of NAVCRIT and REQ revealed distinct differences, by aircraft type, of the pilot's perception of Nav/WSO/EWO contribution to combat mission effectiveness.

N92-28346#
Defence Research Establishment, Ottawa (Ontario).
MODELLING OF HEAT AND MOISTURE LOSS THROUGH NBC ENSEMBLES
BRAD CAIN and RANDALL OSCZEVSKI Nov. 1991 30 p (AD-A245399) Avail: CASI HC A03/MF A01

This report summarizes work done to model the heat and moisture transport through various nuclear, bacteriological, chemical (NBC) clothing ensembles. The analysis involves simplifying the three dimensional physical problem of clothing on a person to that of a one dimensional problem of flow through parallel layers of clothing and air. Body temperatures are calculated based on prescribed work rates, ambient conditions and clothing properties. Sweat response and respiration rates are estimated based on empirical data to provide appropriate boundary conditions at the skin. Core and skin temperatures are calculated during the analysis and reported as functions of time for four different clothing ensembles. Evaporative heat loss was found to be the dominant heat loss mechanism. Estimates of the rate of sweat evaporation through the clothing ensembles is made. The predicted temperature responses, although not exact, are comparable to results from physiological experiments but somewhat lower. Work tolerance times were predicted to be longer than that found experimentally.

N92-28518#
Naval Postgraduate School, Monterey, CA.
CORRELATIONAL ANALYSIS OF SURVEY AND MODEL-GENERATED WORKLOAD VALUES M.S. Thesis
JAMES J. GALVIN, JR Sep. 1991 98 p (AD-A247153) Avail: CASI HC A05/MF A02

This study examines the accuracy of an Army helicopter pilot workload measuring model called the Task Loading Model. The model is a submodel of the Army-NASA Aircrew/Aircraft Integration Program's Man-Machine integration Design and Analysis System. The model's workload level output was correlated with the subjective workload measurements of several groups of pilots evaluating a variety of flight tasks. Seventy-one Army aviators completed surveys requiring scaled ratings and paired comparisons of workload related to common flight tasks conducted during typical missions. Their responses were examined for internal consistency and pooling by means of nonparametric tests. Aviator-supplied data was found to be robust and reliable. Pooled response data was used to develop psychometric data to determine the accuracy of the model. Results of this study show that the Task Loading Model is presently inadequate, but displays promising trends and should be further refined.

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the leachate was necessary to prevent accumulation of dissolved within CELSS based on equivalent wheat yield in leachate and the soluble fraction of inedible wheat biomass (leachate). Recycled on inorganic salts (modified Hoagland’s) with solutions based on contained in waste material, into plant growth systems. One depends, in large part, on the ability to recycle inorganic nutrients, growth and waste recycling systems can be effectively coupled nutrients in leachate solutions provided the majority of mineral significant waste (resource) stream is inedible plant material. This Controlled Ecological Life Support System (CELSS) program

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A two phase effort was conducted to assess the capabilities and limitations of the DataGlove, a lightweight glove input device that can output signals in real-time based on hand shape, orientation, and movement. The first phase was a period for system integration, checkout, and familiarization in a virtual environment. The second phase was a formal experiment using the DataGlove as input device to control the protoflight manipulator arm (PFMA) - a large telerobotic arm with an 8-ft reach. The first phase was used to explore and understand how the DataGlove functions in a virtual environment, build a virtual PFMA, and consider and select a reasonable teleoperation control methodology. Twelve volunteers (six males and six females) participated in a 2 x 3 (x 2) full-factorial formal experiment using the DataGlove to control the PFMA in a simple retraction, slewing, and insertion task. Two within-subjects variables, time delay (0, 1, and 2 seconds) and PFMA wrist flexibility (rigid/flexible), were manipulated. Gender served as a blocking variable. A main effect of time delay was found for slewing and total task times. Correlations among questionnaire responses, and between questionnaire responses and session mean scores and gender were computed. The experimental data were also compared with data collected in another study that used a six degree-of-freedom handcontroller to control the PFMA in the same task. It was concluded that the DataGlove is a legitimate teleoperations input device that provides a natural, intuitive user interface. From an operational point of view, it compares favorably with other ‘standard’ telerobotic input devices and should be considered in future trades in teleoperation systems designs. Author

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A comprehensive study to develop software to simulate the dynamic operation of water reclamation systems in long-term closed-loop life support systems is being carried out as part of an overall program for the design of systems for a moon station or a Mars voyage. This project is being done in parallel with a similar effort in the Department of Chemistry to develop durable accurate low-cost sensors for monitoring of trace chemical and biological species in recycled water supplies. Aspen-Plus software is being used on a group of high-performance work stations to develop the steady state descriptions for a number of existing technologies. Following completion, a dynamic simulation package will be developed for determining the response of such systems to changes in the metabolic needs of the crew and to upsets in system hardware performance. Author

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The development of bioregenerative systems as part of the Controlled Ecological Life Support System (CELSS) program depends, in large part, on the ability to recycle inorganic nutrients, contained in waste material, into plant growth systems. One significant waste (resource) stream is inedible plant material. This research compared wheat growth in hydroponic solutions based on inorganic salts (modified Hoagland’s) with solutions based on the soluble fraction of inedible wheat biomass (leachate). Recycled nutrients in leachate solutions provided the majority of mineral nutrients for plant growth, although additions of inorganic nutrients to leachate solutions were necessary. Results indicate that plant growth and waste recycling systems can be effectively coupled within CELSS based on equivalent wheat yield in leachate and Hoagland solutions, and the rapid mineralization of waste organic material in the hydroponic systems. Selective enrichment for microbial communities able to mineralize organic material within the leachate was necessary to prevent accumulation of dissolved organic matter in leachate-based solutions. Extensive analysis of microbial abundance, growth, and activity in the hydroponic systems indicated that addition of soluble organic material from plants does not cause excessive microbial growth or ‘biofouling’, and helped define the microbially-mediated flux of carbon in hydroponic solutions. Author

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The details of our initial study of the control problem of the crop shoot environment of a hypothetical closed crop growth research chamber (CGRC) are presented in this report. The configuration of the CGRC is hypothetical because neither a physical subject nor a design existed at the time the study began, a circumstance which is typical of large scale systems control studies. The basis of the control study is a mathematical model which was judged to adequately mimic the relevant dynamics of the system components considered necessary to provide acceptable realism in the representation. Control of pressure, temperature, and flow rate of the crop shoot environment, along with its oxygen, carbon dioxide, and water concentration is addressed. To account for mass exchange, the group of plants is represented in the model by a source of oxygen, a source of water vapor, and a sink for carbon dioxide. In terms of the thermal energy exchange, the group of plants is represented by a surface with an appropriate temperature. Most of the primitive equations about an experimental operating condition and a state variable representation which was extracted from the linearized equations are presented. Next, we present the results of a real Jordan decomposition and the repositioning of an undesirable eigenvalue via full state feedback. The state variable representation of the modeling system is of the nineteenth order and reflects the eleven control variables and eight system disturbances. Five real eigenvalues are very near zero, with one at zero, three having small magnitude positive values, and one having a small magnitude negative value. A Singular Value Decomposition analysis indicates that these non-zero eigenvalues are not results of numerical error. Author

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time using the STOL flight simulator. The objectives of these simulator tests were: (1) to confirm the display format which was modified after flight test results of the Beechcraft Queen-Air (a NAL research aircraft); (2) to evaluate the radar guidance functions which telelink information displayed in the HUD; and (3) to study the QSTOL's Instrument Flight Rules (IFR) approach capability using the HUD's radar guidance ability. Results of about 300 simulated approach and landing flights which were evaluated by five test pilots showed: (1) display format modifications improved readability and smoothness of the display's motion; (2) the radar guidance algorithm which obtains aircraft position using a tracking radar that is complemented by inertial information was determined to be satisfactory for use in actual flight; and (3) by using the HUD, and especially its indicated runway image, pilots were able to make precise approaches to the runway under Instrument Meteorological Conditions. In addition, other beneficial suggestions for display format final adjustments were obtained prior to HUD's use in the QSTOL flight test series.

Author (NASDA)

N92-28897* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. EXPERIMENTAL MEASUREMENT OF THE ORBITAL PATHS OF PARTICLES SEDIMENTING VISCOS FLUID AS INFLUENCED BY GRAVITY. DAVID A. WOLF and RAY P. SCHWARZ (Krug Life Sciences, Inc., Houston, TX.) June 1992 19 p


This report describes recommended methods for scanning the flight path, and cockpit instruments for pilots wearing night vision gogles (NVGs) while flying Army helicopters. The impetus for this report was a task force sponsored by the Office of the Deputy Chief of Staff of the Army for Plans and Operations, which determined that the development of scanning methods was the Army's top training priority for night helicopter operations. The recommended methods of scanning were derived from published scientific works, interviews with scientists, and interviews with aviators from field tactical units, training units, and from the research and development community. The proposed scanning methods recommend free search as opposed to formatted scan patterns. In addition, they place equal weight on crew coordination and individual technique. The proposed methods stress actions taken before flight, such as premission planning and NVG preflight adjustments. Furthermore, the proposed methods are intended to build an awareness of: NVG performance limits, and how to maximize performance; common problems encountered while scanning with NVGs, and the conditions which elicit them; and the scientific basis for scanning. Separate scanning methods were developed for individuals and for crews. In addition, the relevant scientific literature was reviewed.

Author (NASDA)


Work by Dr. Durlach and his collaborators is summarized here. The creation of a serious journal for continuing publication of peer-reviewed papers seemed essential for the development of the field (both technically and academically). Thus, the funds in this grant were used to support the creation of a journal rather than a book. The journal is 'Presence: teleoperators and virtual environments,' published by MIT Press. The work performed to start the journal has occurred in two phases. The first consisted of establishing the journal as an organization entity. The second, which has only been completed within the past month, consisted of generating the first issue.

Author (NASDA)


A computer-simulated cortical network is presented. The network is capable of computing the visibility of shifts in the direction of movement. Additionally, the network can compute the following: (1) the magnitude of the position difference between the test and background patterns; (2) localized contrast differences at different spatial frequencies analyzed by computing temporal gradients of the difference and sum of the outputs of paired even- and odd-symmetric bandpass filters convolved with the input pattern; and (3) the direction of a test pattern moved relative to a textured background. The direction of movement of an object in the field of view of a robotic vision system is detected in accordance with nonlinear Gabor function algorithms. The movement of objects relative to their background is used to infer the 3-dimensional structure and motion of object surfaces.

Official Gazette of the U.S. Patent and Trademark Office


The subject invention relates to a human cleansing agent particularly suitable for use in long duration spacecraft and to a
method of bathing with the agent. The agent of the subject invention is in the form of a paste having a pH of 5.0 to 7.9 which comprises an acyltaurate, a skin conditioner, a hair conditioner, and a preservative. More specifically, it includes sodium N-coconut acid-N-methyl taurate, in combination with soybean lecithin, polyquaternium 16, and formalin. This particular combination satisfies the following objectives: (1) that it be usable with a minimum amount of water per shower (approximately 1 gallon); (2) that it be easily separated from the water for purposes of water reclamation; (3) that it be pH compatible with skin and hair; (4) that it rinse well in deionized water; (5) that it be mild to skin and eyes; (6) that it effectively clean both skin and hair; (7) that it be suitable for use in zero gravity; and (8) that it provide ease of combing of wet and dry hair. The method of the invention includes the steps of wetting the skin and hair with a small quantity of water, lathering the skin with the paste, rinsing the lather from the steps of wetting the skin and hair with a small quantity of water, and then applying the defoamed rinse water to the water reclamation unit for recycling the water. The novelty of the invention appears to lie in the particular formulation of the cleansing agent and its method of use which provide optimal results under the given constraints and objectives.

Official Gazette of the U.S. Patent and Trademark Office

N92-29227# Harvard Coll. Observatory, Cambridge, MA.
THE ENERGETICS AND MECHANICS OF LOAD CARRYING
NORMAN C. HEGLUND 16 Jan. 1992 5 p
(Contract DAA03-88-K-0032)
(AD-A248441) Avail: CASI HC A01/MF A01

African women commonly carry prodigious loads (70 percent or more of their body weight) supported by their heads for long distances. This method of load carriage is very economical; in a comparison of the metabolic cost of carrying large head-supported loads (by African women) to large back-supported loads (by American army recruits), it was found that the army recruits had to increase their metabolism twice as much as the women for the same load at the same walking speed. The mechanism by which these women carry loads so economically is unknown. The purpose of this study was to develop a quantitative understanding of how these women are able to carry head-supported loads so cheaply.

GRA

N92-29348# Army Aeromedical Research Lab., Fort Rucker, AL.
VISUAL ACUITY WITH SECOND AND THIRD GENERATION NIGHT VISION GOGGLES OBTAINED FROM A NEW METHOD OF NIGHT SKY SIMULATION ACROSS A WIDE RANGE OF TARGET CONTRAST Final Report
JOHN C. KOTULAK and CLARENCE E. RASH Jan. 1992 42 p
(Contract DAAD17-86-K-0011; AD-A233477)
(AD-A248294; USAARL-92-9) Avail: CASI HC A03/MF A01

The purpose of this investigation was to study the primary factors which influence visual acuity (VA) with night vision goggles (NVGs). These factors are: night sky condition, target contrast, and NVG generation. Improved methods were used to simulate the night sky and to control for differences in target contrast which result from dissimilarities in spectral sensitivity between NVG generations. The new simulation method used combinations of spectrally flat (neutral density) and wavelength selective (blue glass) filters to reproduce the spectral distribution of the night sky across the entire NVG response range. Between-generation differences in target contrast were eliminated by weighting the incident radiant flux by the sensitivity of the detector. It was found that the difference in VA between the two generations widens under two conditions: (1) when target contrast is constant and night sky irradiance decreases; and (2) when night sky irradiance is constant and target contrast decreases. Furthermore, it was found that for a given NVG generation, VA falls off more rapidly for a low contrast target than for a high contrast target when night sky irradiance decreases.

GRA

N92-29413# Sterling (Walter V.), Inc., Palo Alto, CA.
ARMY-NASA AIRCREW/AIRCRAFT INTEGRATION PROGRAM:
PHASE 4 (A3) MAN-MACHINE INTEGRATION DESIGN AND
ANALYSIS SYSTEM (MIDAS) SOFTWARE DETAILED DESIGN DOCUMENT
CAROLYN BANDA, DAVID BUSHNELL, SCOTT CHEN, ALEX CHIU, BETSY CONSTANTINE, JERRY MURRAY, CHRISTIAN NEUKOM, MICHAEL PREVOST, RENUKA SHANKAR, and LOWELL STAVELAND Dec. 1991 514 p
(Contract NAS2-13210)
(NASA-CR-177593; A-92049; NAS 1.26:177593) Avail: CASI HC A22/MF A04

The Man-Machine Integration Design and Analysis System (MIDAS) is an integrated suite of software components that constitutes a prototype workstation to aid designers in applying human factors principles to the design of complex human-machine systems. MIDAS is intended to be used at the very early stages of conceptual design to provide an environment wherein designers can use computational representations of the crew station and operator, instead of hardware simulators and man-in-the-loop studies, to discover problems and ask 'what if' questions regarding the projected mission, equipment, and environment. This document is the Software Product Specification for MIDAS. Introductory descriptions of the processing requirements, hardware/software environment, structure, I/O, and control are given in the main body of the document for the overall MIDAS system, with detailed discussion of the individual modules included in Annexes A-J.

Author

N92-29538# Analysis and Technology, Inc., New London, CT.
EVALUATION OF NIGHT VISION GOGGLES (NVG) FOR
(Contract DTG739-89-C-00671)
(AD-A247162; CGR/DC-19/91; USCG-D-03-92) Avail: CASI HC A06/MF A02

Three experiments were conducted during 1989 and two more have been conducted during 1990 by the U.S. Coast Guard Research and Development (R&D) Center to evaluate night vision goggles (NVGs) for their effectiveness in detecting small targets at night. Three types of NVGs were evaluated: the AN/AVS-6 Aviators Night Vision Imaging System (ANVIS) NVG was tested onboard Coast Guard HH-3 and CH-3 helicopters, and the AN/PVS-5C and AN/PVS-7A NVGs were tested onboard 41-foot Coast Guard utility boats (UTBs). During the Fall 1990 experiment, 4-and 6-person unit life rafts, with and without retro-reflective tape and 18-and 21-foot white boats were employed as targets during realistically-simulated search missions and are discussed herein. A large quantity of well moonlit data were collected during the fall 1990 experiment and this third interim report discusses target types where new information was obtained. A total of 1,612 target detection opportunities were generated for the above-mentioned target types during the five experiments. These data were analyzed to determine which of 25 search parameters of interest exerted a statistically-significant influence on target detection probability. Lateral range curves and sweep width estimates are developed for each search unit/target type combination. Human factors data are presented and discussed. Recommendations for conducting NVG searches for small targets and for additional data collection and analysis are provided.

GRA

N92-29949# Texas Technological Univ., Lubbock. Dept. of Industrial Engineering.
DEVELOPMENT OF MODELS FOR PREDICTION OF OPTIMAL LIFTING MOTION Final Report
M. M. AYOUB 30 Sep. 1991 106 p
Prepared for Centers for Disease Control, Atlanta, GA
(Contract NIOSH-R01-OH-02434)
(PB92-164656) Avail: CASI HC A06/MF A02

The angular movement of five human joints was simulated based on the invariant characteristics of manual lifting that are
multidirectional and multiaxial and executed by large muscle groups generating within maximum torques. The study dealt with only one set of performance limitations of manual lifting, those produced by the understanding of human physical capacities and task requirements. It was assumed that the body will perform the lifting motion pattern in such a fashion so as to minimize a cost function. Therefore, the focus of the research was to identify the paths of motion of each of five selected joints (elbow, shoulder, hip, knee, and ankle) within the feasible space which will minimize the cost function. Three different optimization searching algorithms were introduced to minimize the objective function representing the total work done in lifting. These algorithms were: heuristic dynamic programming, filtering by total enumeration, and the general reduced gradient algorithm. A comparison was made between the prediction of the five selected joints to the actual paths to illustrate the validity of the model.

Author

N92-30125*# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.

HUMAN FACTORS IN AIRCRAFT MAINTENANCE AND INSPECTION

The events which have led to the intensive study of aircraft structural problems have contributed in no less measure to the study of human factors which influence aircraft maintenance and inspection. Initial research emphasis on aging aircraft maintenance and inspection has since broadened to include all aircraft types. Technicians must be equally adept at repairing old and new aircraft. Their skills must include the ability to repair sheet metal and composite materials; control cable and fly-by-wire systems; round dials and glass cockpits. Their work performance is heavily influenced by others such as designers, technical writers, job card authors, schedulers, and trainers. This paper describes the activities concerning aircraft and maintenance human factors.

Author

N92-30126*# Galaxy Scientific Corp., Atlanta, GA.

USING INTELLIGENT SIMULATION TO ENHANCE HUMAN PERFORMANCE IN AIRCRAFT MAINTENANCE

Human factors research and development investigates the capabilities and limitations of the human within a system. Of the many variables affecting human performance in the aviation maintenance system, training is among the most important. The advent of advanced technology hardware and software has created intelligent training simulations. This paper describes the activities concerning aircraft and maintenance human factors.

Author

SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A92-46443

WHAT MAKES A PLANET HABITABLE, AND HOW TO SEARCH FOR HABITABLE PLANETS IN OTHER SOLAR SYSTEMS
MICHAEL D. PAPAGIANNIS (Boston University, MA) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 6, June 1992, p. 227-230. refs Copyright

This review examines the characteristics of habitable planets where biologically advanced life could exist and lists some observational search techniques for such planets. Attention is given to the presence of liquid water and the importance of organic molecules, and consideration is given to temperature and the development of ozone layers in habitable planets. The availability of O2 and/or O3 in the atmospheres of these planets is shown to be a critical precondition for habitability. Where there are life forms on planets it is shown that oxygen is likely to accumulate in the atmosphere; this suggests that large IR arrays can be used to search for planets with free oxygen and ozone in their atmospheres. These planets are acknowledged to be more common than those with technologically advanced civilizations suggesting that the search for life in space could be expanded in this direction.

C.C.S.

A92-46445

CHEMICAL STUDIES ON THE EXISTENCE OF EXTRATERRESTRIAL LIFE
CYRIL PONNAMPERUMA, YASUHIRO HONDA, and RAFAEL NAVARRO-GONZALEZ (Maryland, University, College Park) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 6, June 1992, p. 241-249. refs Copyright

A composite scenario is developed based on synthetic experiments and analytical studies to describe the origin of life. The theories proposed by Oparin (1967) and Haldane (1967) are used to structure the knowledge synthesized from observations of the atmosphere, geology, and chemistry on earth. Particular treatment is given to the sources of energy on the primitive earth and the roles of monomers, oligomers, amino acids/nucleotides, and trace metal ions in the chemical evolution. Also reviewed are chiral race, meteorite composition, interstellar matter and comets, and the composition of lunar samples. A scenario is described with five stages for the development of life in the universe detailing: (1) the synthesis of organic molecules during planet formation; (2) the accumulation of monomers and polymers in the lithosphere-atmosphere-hydrosphere system; (3) cometary delivery of organic matter; and (4) the evolution of 'protobionts' into prymordial cells.

C.C.S.

A92-46446

CHEMISTRY OF THE INTERSTELLAR MEDIUM - AN EVOLUTIONARY DEAD END?
M. D. NUSINOV, V. V. BURDIUZHA (Rossiskaia Akademiia Nauk, Fizicheskii Institut, Moscow, Russia), and S. I. GLEIZER (Interbios, Moscow, Russia) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 6, June 1992, p. 251-255. Translation. refs Copyright

Data are presented which show that biological evolution as it is presently understood is not tenable within the interstellar medium. Particular attention is given to the initial physicochemical precellular stages of evolution and to the composition of interstellar gas-dust clouds. General descriptions are given of dust-grain composition and interstellar molecules. Biological evolution is shown to require the simultaneous presence of liquid water, solid surfaces, and some definite carbon compounds. The function of mineral particles such as clay and clay minerals in evolutionary progress is assessed, and experimental evidence is listed that points to problems in the origin of chirality. Maximum bond energy occurs in molecules with 10-20 atoms, and a further increase is possible but with lower specific bond energies and low probabilities of formation. Therefore the increase in molecular complexity appears to come to a 'dead end' in the interstellar medium.

C.C.S.

A92-46447

TITAN AND EXOBIOLOGICAL ASPECTS OF THE CASSINI-HUYGENS MISSION

This review examines the characteristics of Titan's atmosphere, geology, and composition. Particular attention is given to the simultaneous presence of liquid water, solid surfaces, and some definite carbon compounds. The function of Titan's atmosphere in the evolution of life is assessed, and experimental evidence is listed that points to problems in the origin of chirality. Maximum bond energy occurs in molecules with 10-20 atoms, and a further increase is possible but with lower specific bond energies and low probabilities of formation. Therefore the increase in molecular complexity appears to come to a 'dead end' in the interstellar medium.

C.C.S.
The joint NASA-ESA Cassini-Huygens mission is discussed in terms of the study of extraterrestrial organic processes with the orbiter and the probe on or near Titan. The satellite of Saturn is described generally with specific references to the chemical composition of the stratospheric and atmospheric organic compounds. The compounds that are already known to exist near Titan are confirmed with results from simulations and models of N2-CH4 evolution and other processes. The organic chemistry of Titan's surface is expected to have an ocean and strong surface-atmosphere coupling, and the principal likely components of the ocean are set forth. The Cassini-Huygens mission is expected to provide data that describe the atmosphere, aerosols, and hypothesized oceans. These data are important for learning more about prebiotic chemistry generally and for gas-phase organic chemistry at low temperatures.

C.C.S.

A92-48100* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ON PERFORMING EXOBIOLOGY EXPERIMENTS ON AN EARTH-ORBITAL PLATFORM WITH THE GAS-GRAIN SIMULATION FACILITY

JUDITH L. HUNTINGTON and GUY FOGLEMAN (NASA, Ames Research Center; SETI Institute; Moffett Field, CA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 3-5, 1989, p. 493, 494. refs

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Laboratory simulations of gas-dust interactions performed on Space Station Freedom in the Gas-Grain Simulation Facility (GGSF) are considered for studying the nature of bodies in the solar system. The GGSF includes a 4-10 liter chamber for experiments with the capability for environmental control, measurement, levitation, and energy. The simulations can provide low gas pressure and dust density in a microgravitational environment.

C.C.S.

A92-48179

ORGANIC COMPOUNDS IN THE FOREST VALE, H4 ORDINARY CHONDRITE

RENATO ZENOBI, JEAN-MICHEL PHILIPPOZ, RICHARD N. ZARE (Stanford University, CA), MICHAEL R. WING, JEFFREY L. BADA (Scripps Institution of Oceanography, La Jolla, CA), and KURT MARTI (California, University, La Jolla) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 56, no. 7, July 1992, p. 2899-2905. Research supported by IBM Corp. and U.S. Navy. refs

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The H4 ordinary chondrite Forest Vale was analyzed for polycyclic aromatic hydrocarbons (PAHs), using two-step laser mass spectrometry (L2MS) and, for amino acids, using a standard chromatographic method. Indigenous PAHs were identified in the matrices of freshly cleaved interior faces but could not be detected in pulverized silicates and chondrules. No depth dependence of the PAHs was found in a chipped interior piece. Amino acids, taken from the entire sample, consisted of protein amino acids that were nonracemic, indicating that they are terrestrial contaminants. The presence of indigenous PAHs and absence of indigenous amino acids provides support for the contention that different processes and environments contributed to the synthesis of the organic matter in the solar system.

Author

A92-48225* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COLLECTION OF COSMIC DUST IN EARTH ORBIT FOR EXOBIOLICAL ANALYSIS

GUY FOGLEMAN, JUDITH L. HUNTINGTON (SETI Institute; NASA, Ames Research Center, Moffett Field, CA), and GLENN C. CARLE (NASA, Ames Research Center, Moffett Field, CA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 3-5, 1989, p. 465, 466. refs

Copyright

Two proposed NASA exobiology flight experiments are described in terms of the approaches to cosmic dust collection and the issues addressed by the analysis of the samples. A passive collector is planned for use with the Cosmic Dust Collection Facility, and an active system is described for attachment to the Space Station Freedom payload. Exobiological study of cosmic dust could provide insights on organic chemistry in the grains and on the relative abundances of biogenic elements in interstellar, cometary, and meteoric samples.

C.C.S.
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