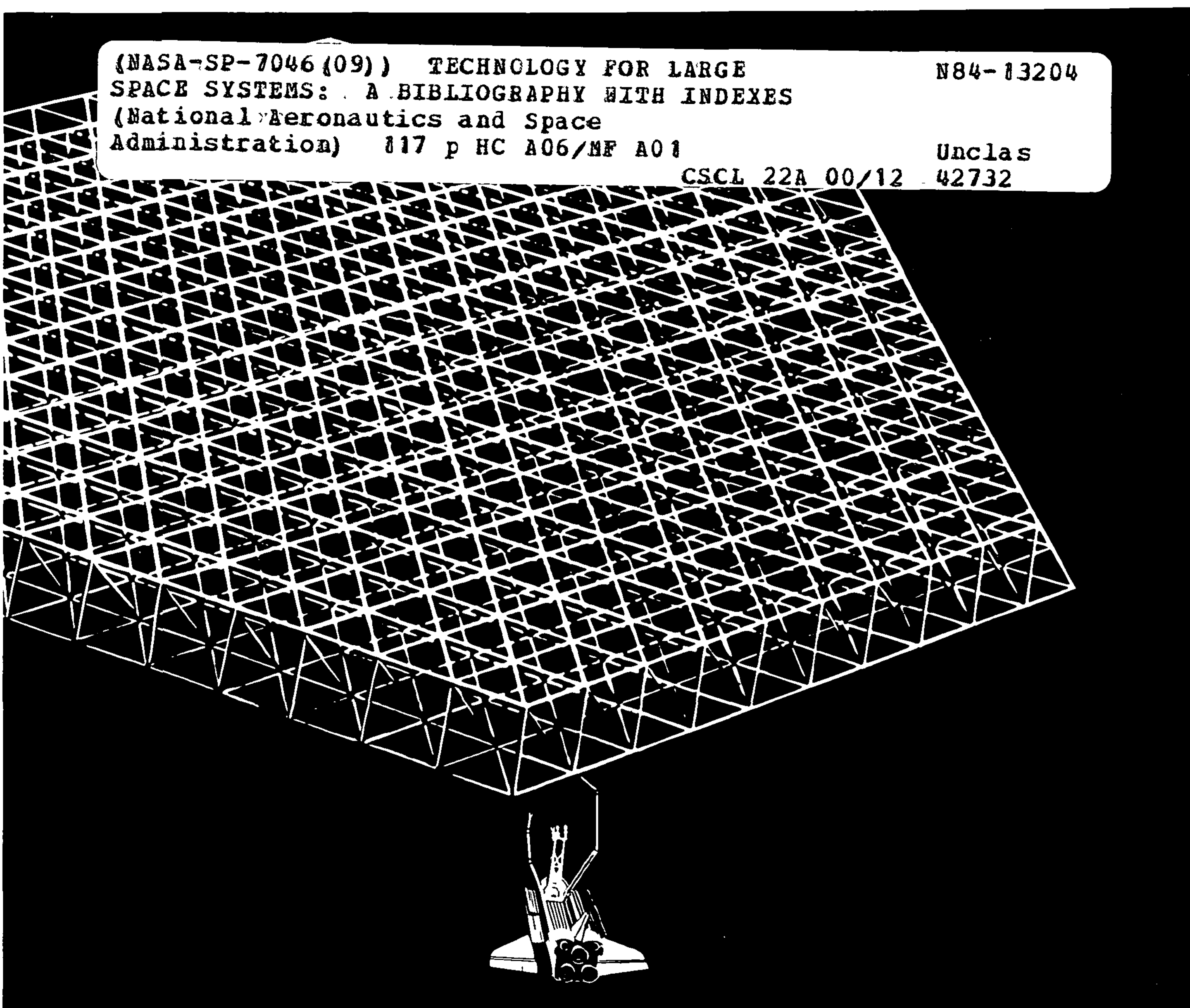
NASA

Technology for Large Space Systems

A Bibliography with Indexes

NASA SP-7046(09)
July 1983

25th Anniversary
1958-1983



NASA SP-7046(09)

TECHNOLOGY FOR LARGE SPACE SYSTEMS

A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 9

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system between January 1 and June 30, 1983 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

NASA Scientific and Technical Information Branch 1983
National Aeronautics and Space Administration
Washington, DC

NOTE TO AUTHORS OF PROSPECTIVE ENTRIES

The compilation of this bibliography results from a complete search of the *STAR* and *IAA* files. Many times a report or article is not identified because either the title, abstract, or key words did not contain appropriate words for the search A number of words are used, but to best insure that your work is included in the bibliography, use the words *Large Space Structures* somewhere in your title or abstract, or include them as a key word

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161 at the price code A06 ($13 00 domestic; $26 00 foreign)

INTRODUCTION

This bibliography is designed to be helpful to the researcher and manager engaged in developing technology within the discipline areas of the Large Space Systems Technology Also, the designers of large space systems for approved missions (in the future) will utilize the technology described in the documents referenced herein

This literature survey lists 414 reports, articles and other documents announced between January 1, 1983 and June 30, 1983 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*

The coverage includes documents that define specific missions that will require large space structures to achieve their objectives The methods of integrating advanced technology into system configurations and ascertaining the resulting capabilities is also addressed

A wide range of structural concepts are identified These include erectable structures which are earth fabricated and space assembled, deployable platforms and deployable antennas which are fabricated, assembled, and packaged on Earth with automatic deployment in space, and space fabricated structures which use pre-processed materials to build the structure in orbit

The supportive technology that is necessary for full utilization of these concepts is also included. These technologies are identified as analysis and design techniques, structural and thermal analysis, structural dynamics and control, electronics, advanced materials, assembly concepts, and propulsion

A General category completes the list of subjects addressed by this document

The selected items are grouped into ten categories as listed in the Table of Contents with notes regarding the scope of each category These categories were especially selected for this publication and differ from those normally found in *STAR* and *IAA*

Each entry consists of a standard bibliographic citation accompanied by an abstract where available, and appears with the original accession numbers from the respective announcement journals

Under each of the ten categories, the entries are presented in one of two groups that appear in the following order

1) *IAA* entries identified by accession number series A83-10,000 in ascending accession number order,
2) *STAR* entries identified by accession number series N83-10,000 in ascending accession number order

After the abstract section there are six indexes - subject, personal author, corporate source, contract number, report number, and accession number.

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc (AIAA), as follows Paper copies of accessions are available at $8 50 per document Microfiche[(1)] of documents announced in *IAA* are available at the rate of $4 00 per microfiche on demand, and at the rate of $1 35 per microfiche for standing orders for all *IAA* microfiche

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NASA SPONSORED DOCUMENT — AVAILABLE ON MICROFICHE

NASA ACCESSION NUMBER — **N83-20003*#** Massachusetts Inst of Tech, Cambridge Lab for Information and Decision Systems — CORPORATE SOURCE

TITLE — **GUARANTEED ROBUSTNESS PROPERTIES OF MULTIVARIABLE, NONLINEAR, STOCHASTIC OPTIMAL REGULATORS**

AUTHORS — J N TSITSIKLIS and M ATHANS Feb 1983 18 p refs — PUBLICATION DATE

Presented at the 22nd IEEE Conf on Decision and Control

CONTRACT OR GRANT — (Contract NGL-22-009-124)

REPORT NUMBER — (NASA-CR-170068, NAS 1 26 170068, LIDS-P-1283) Avail NTIS HC A02/MF A01 CSCL 09C — AVAILABILITY SOURCE

The robustness of optimal regulators for nonlinear, deterministic and stochastic, multi-input dynamical systems is studied under the assumption that all state variables can be measured It is shown that, under mild assumptions, such nonlinear regulators have a guaranteed infinite gain margin, moreover, they have a guaranteed 50 percent gain reduction margin and a 60 degree phase margin, in each feedback channel, provided that the system is linear in the control and the penalty to the control is quadratic, thus extending the well-known properties of LQ regulators to nonlinear optimal designs These results are also valid for infinite horizon, average cost, stochastic optimal control problems B W

TYPICAL CITATION AND ABSTRACT FROM *IAA*

NASA SPONSORED DOCUMENT — AVAILABLE ON MICROFICHE

AIAA ACCESSION NUMBER — **A83-12475*#** TRW, Inc, Redondo Beach, Calif

OPTIMAL SUN-ALIGNMENT TECHNIQUES OF LARGE SOLAR ARRAYS IN ELECTRIC PROPULSION SPACECRAFT — TITLE

AUTHORS — H F MEISSINGER, C L DAILEY (TRW, Inc, Space and Technology Group, Redondo Beach, CA), and M E VALGORA (NASA, Lewis Research Center, Cleveland, OH) — AUTHOR'S AFFILIATION

AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 13 p refs — MEETING — MEETING DATE

CONTRACT, GRANT OR SPONSORSHIP — (Contract NAS3-22661)

(AIAA PAPER 82-1898)

Optimum sun-alignment of large solar arrays in electric propulsion spacecraft operating in earth orbit requires periodic roll motions around the thrust axis, synchronized with the apparent conical motion of the sun line This oscillation is sustained effectively with the aid of gravity gradient torques while only a small share of the total torque is being contributed by the attitude control system Tuning the system for resonance requires an appropriate choice of moment-of-inertia characteristics To minimize atmospheric drag at low orbital altitudes the solar array is oriented parallel, or nearly parallel, to the flight direction This can increase the thrust-to-drag ratio by as much as an order of magnitude Coupled with optimal roll orientation, this feathering technique will permit use of electric propulsion effectively at low altitudes in support of space shuttle or space station activities and in spiral ascent missions (Author)

TECHNOLOGY FOR LARGE SPACE SYSTEMS

A Bibliography (Suppl. 9)

JULY 1983

01

SYSTEMS

Includes mission and program concepts and requirements, focus missions, conceptual studies, technology planning, systems analysis and integration, and flight experiments

A83-10428
SOLAR SATELLITES [SATELLITES SOLAIRES]
C POHER (Centre National d'Etudes Spatiales, Paris, France) L'Aeronautique et l'Astronautique, no 95, 1982, p 13-20 In French

A reference system design, projected costs, and the functional concepts of a satellite solar power system (SSPS) for converting sunlight falling on solar panels of a satellite in GEO to a multi-GW beam which could be received by a rectenna on earth are outlined Electricity transmission by microwaves has been demonstrated, and a reference design system for supplying 5 GW dc to earth was devised The system will use either monocrystalline Si or concentrator GaAs solar cells for energy collection in GEO Development is still needed to improve the lifespan of the cells Currently, the cell performance degrades 50 percent in efficiency after 7-8 yr in space Each SSPS satellite would weigh either 34,000 tons (Si) or 51,000 tons (GaAs), thereby requiring the fabrication of a heavy lift launch vehicle or a single-stage-to-orbit transport in order to minimize launch costs Costs for the solar panels have been estimated at $500/kW using the GaAs technology, with transport costs for materials to GEO being $40/kg M S K

A83-10702
ORBITAL RING SYSTEMS AND JACOB'S LADDERS. I
P BIRCH (Marconi Space and Defense Systems, Ltd , Stanmore, Middx , England) British Interplanetary Society, Journal (Interstellar Studies), vol 35, Nov 1982, p 474-497 refs

A description and assessment is presented for the variety of 'orbital ring' system configurations and functions Such systems obviate rocket propulsion, transferring payloads into orbit by accelerating them along cables that are suspended at 'Skyhook' points from a ring whose circumference corresponds to a low earth orbit The cable ascent systems are designated 'Jacob's ladders', and it is suggested that they transport payloads to space by means of superconducting magnet-equipped linear induction motor systems similar to those proposed for mass drivers Quantitative estimates are presented for ladder payloads and system throughputs For stress-free operation, an orbital ring must be in free fall, except at the locations from which cables are suspended Attention is given to atmospheric effects on rings and cables, and to the possibility of eccentric and partial rings O C

A83-11932
ADVANCED OPERATIONAL EARTH RESOURCES SATELLITE SYSTEMS
S W MCCANDLESS (User Systems Engineering, Annandale, VA) and P M MAUGHAN (COMSAT General Corp , Washington, DC) In Spacelab, space platforms and the future, Proceedings of the Fourth Joint AAS/DGLR Symposium and Twentieth Goddard Memorial Symposium, Washington, DC, March 17-19, 1982 San Diego, CA, Univelt, Inc , 1982, p 293-308
(AAS 82-128)

Spacecraft instrumentation and design, business objectives, and space technologies being developed and used by various nations in the near term are reviewed The French are preparing the SPOT satellite for earth resouces mapping, while the ERS-1 spacecraft are being developed by both ESA and Japan, with capabilities similar to SEASAT and the GOES satellites Communications satellites will implement the 30/20 GHz bands, multiple spot beam antennas, and large unmanned multiservice satellite systems Predicted space missions in the period 1982-1991 are provided, including mention of satellite business communication services, direct broadcast television services, electronic mail, and international information services At least four U S environmental monitoring satellites will be in orbit at any one time Finally, the use of multisensor platforms is noted to potentially reduce the launch volume demands on the Shuttle and ballistic missile systems M S K

A83-13215
THE MECHANICS OF AN ANCHORED LUNAR SATELLITE [MEKHANIKA LUNNOI TROSOVOI SISTEMY]
V V BELETSKII and E M LEVIN Kosmicheskie Issledovaniia, vol 20, Sept -Oct 1982, p 760-765 In Russian refs

The requirements that an anchored lunar satellite must satisfy are examined, with emphasis on two questions (1) whether a taut tether which connects the lunar surface with a satellite at the L2 (or L1) equilibrium point can have a stable equilibrium position, and (2) whether a tether of such length (65,000 km) can withstand the stresses that are entailed and meet the necessary technical requirements Tethers made of different materials (glass, boron, quartz, and Kevlar) are examined, and it is concluded that the above-mentioned requirements are not impossible to satisfy In particular, it is found that a station with a mass of 2 5 thousand tons can be held by a tether 100-thousand kilometers long with a mass of 100 tons and a cross section of 0 3 mm B J

A83-13899
DBS PLATFORMS - A VIABLE SOLUTION
N L COHEN and G R STONE (General Dynamics Corp , Convair Div , San Diego, CA) Satellite Communications, vol 6, Dec 1982, p 22-25, 27

Various design options for the basic direct broadcast satellite (DBS) system are discussed The first generation spacecraft are constrained by time zone problems, noting that one unit is insufficient to provide direct TV to an entire continent An 800 W traveling wave amplifier is sufficient for full coverage of the entire U S , while 200 W amplifiers are capable of single channel broadcast to a quarter to a third of the U S land area A total of 24-32 satellites costing a total of $3 2-4 8 billion is required to provide full U S coverage with first generation DBS systems The Shuttle is described as the means to providing GEO DBS services at affordable costs Four large platforms, weighing 5300 kg, could be placed in GEO by a Centaur transfer stage after launch into LEO on the Shuttle Studies have shown that four platforms, each with a 40 channel capability, power generating capacity of 30 kW, and 100% eclipse capability, could provide coverage for the entire U S Beam-shaping techniques offer any desired illumination pattern Details of the institutional barriers which must be satisfied before the $500 million spacecraft could be launched are outlined M S K

A83-15665#
THE ESA LARGE TELECOMMUNICATIONS SATELLITE PROGRAMME AND ITS PROJECTIONS INTO THE FUTURE
P BARTHOLOME and B HERDAN (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) In International Scientific Conference on Space, 22nd, Rome, Italy, March 25, 26, 1982, Proceedings Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1982, p 135-147

The design goals and status of the L-Sat program (ESA Large Telecommunications Satellite) are reviewed The objectives for the L-Sat are the realization of an orbiting multipurpose platform able to meet cost-competitive requirements, as well as fabrication of communications payload hardware for on-orbit demonstration of a multielement payload which stimulates new services and applications Research areas for the L-Sat comprise definition of the payload mass, power consumption, thermal dissipation, payload layout, antenna deployment, and pointing accuracy specifications Configured for launch by either the Ariane or the STS, the first L-Sat will carry direct TV broadcast equipment, onboard satellite switching and multibeam antennas for business use in Europe, beacon generators at 12, 20, and 30 GHz, and 20/30 GHz transponders The first protoflight is scheduled for the spring of 1986 M S K

A83-15672#
THE TETHERED SATELLITE SYSTEM TECHNICAL ASPECTS AND PROSPECTIVE SCIENTIFIC MISSIONS
G MANARINI (CNR, Rome, Italy) and F MARIANI (Roma, Universita, Rome, CNR, Istituto di Fisica dello Spazio Interplanetario, Frascati, Italy) In International Scientific Conference on Space, 22nd, Rome, Italy, March 25, 26, 1982, Proceedings Rome, Rassegna Internazionale Electronica Nucleare ed Aerospaziale, 1982, p 253-265

Descriptions are given of the two main elements of the Tethered Satellite System (TSS), the Deployer Module and the Satellite Module Also discussed are the physical and technical problems that can be studied by the TSS It is noted that two versions of the mission are planned the upper tether, essentially for electrodynamics-oriented physics, and the lower tether, for atmospheric-ionospheric studies The scientific payloads will be markedly different depending on the particular scientific aim of the mission The first launch of TSS is planned for early 1987, and several scientific groups, both European and non-European, have expressed their interest in joining the venture C R

A83-16590*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
INTERACTIVE SYSTEMS ANALYSIS OF FOUR STRUCTURAL CONCEPTS FOR A LAND MOBILE SATELLITE SYSTEM
M J FEREBEE, JR, L B GARRETT (NASA, Langley Research Center, Space Systems Div, Hampton, VA), and J T FARMER American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 10 p refs
(AIAA PAPER 83-0219)

Weight and structural analysis data were generated for four structural concepts for a Land Mobile Satellite System (LMSS) using the Interactive Design and Evaluation of Advanced Spacecraft (IDEAS) computer-aided design and analysis program Structural concepts analyzed included the wrapped radial rib, box ring, tetrahedral truss, and hoop column Estimates of total spacecraft weight, structural natural frequencies and modal shapes were determined and compared for several loading conditions for each concept Spacecraft-induced and environmental effects on antenna performance (surface accuracy, defocus and boresight offset) are quantified (Author)

A83-16757#
THE ADVANCED SOLAR OBSERVATORY
A B C WALKER, JR (Stanford University, Stanford, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 12 p
(AIAA PAPER 83-0511)

The Advanced Solar Observatory (ASO), a proposed long-duration Space-Shuttle-serviced space observatory, is presented The ASO would play an important role in the development of improved stellar models, and in the study of heliospheric structure and dynamics The spacecraft consists of four major instrument groupings with different operational requirements A High-Resolution Solar Telescope Cluster is intended to carry out studies of solar internal dynamics and the photosphere, chromosphere and low corona at visible, UV, EUV, XUV and soft X-ray wavelengths A Pinhole/Occulter Facility would perform high-resolution studies of the outer corona and solar wind in the visible and UV regions, and of transient phenomena in hard X rays A Solar High Energy Facility is intended for hard X-ray and gamma-ray observations of transient phenomena, and for the study of solar neutrons A Solar Low Frequency Radio Facility is included for studies of particle acceleration and propagation in the corona and inner heliosphere The planned evolutionary development involving the preliminary deployment of separate instruments on Spacelab flights is considered to be both cost-effective and scientifically valuable A L W

A83-16758*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
SOLAR TERRESTRIAL OBSERVATORY FOR FUTURE SPACE STATION PROGRAM
W T ROBERTS (NASA, Marshall Space Flight Center, Program Development Directorate, Huntsville, AL) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 6 p
(AIAA PAPER 83-0512)

The Solar Terrestrial Observatory (STO) Science Study Group was established in 1979 to formulate a scientific strategy for the development of a Solar Terrestrial Observatory as an interdependent problem-oriented combination of solar, magnetospheric, and atmospheric instruments In the scenario formed by the STO Science Study Group, the STO would be mounted on a long-lived Space Platform, carried into orbit, and serviced by the Space Shuttle The proposed strategy focused on investigations of the physical processes that interlink the major regions of solar-terrestrial space In reviewing that strategy, one quickly concludes that the STO objectives can be met, and in many ways enhanced, by using a Shuttle-serviced manned Space Station This conclusion is reinforced by the results of earlier workshops devoted to manned Space Stations (Author)

A83-16817#
CONFIGURATION DESIGN OF A CLOSED-LOOP, PSEUDOGRAVITATIONAL, ENVIRONMENTAL RESEARCH FACILITY IN LOW EARTH ORBIT
J B JONES-OLIVEIRA American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 9 p
(AIAA PAPER 83-0651)

The design of a facility for the Satellite Pseudogravitational Operational Research Environment (SPORE) is discussed Attention is given to the experiment design, design approach, possible configuration designs, and component designs The SPORE mission is described, a potential low earth orbit for the facility is identified, and human-factor design considerations are reviewed Additional issues are briefly considered, including power requirements, radiation protection, communications, propulsion, attitude control, vibration damping, and structural system perturbations F G M

A83-18607

A PLANAR ARRAY ANTENNA FOR TV BROADCASTING COMMUNICATIONS

A CUCCI and A DE LUCA (Selenia S p A , Rome, Italy) In International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings Part 1 London, Institution of Electrical Engineers, 1981, p 28-31

The L-Sat planar array for satellite direct TV broadcasting is described Still in the design stage, the array is intended for broadcasting on the X-band, within the 0 98 x 2 3 deg elliptical beam, sidelobe below -30 dB, circular polarization with low cross-polarization WARC requirements The results of an analysis of the effects produced by the contour profile on the radiation pattern are presented Further work has proceeded on a circuit model of a slot in a single subarray, the coupling of mutual slots, and the phase and amplitude behhavior of the coupled feeding and radiating waveguides Finally, simulations have been performed of the thermally induced deformations, with attention given to warping and a tilted half-plane M S K

A83-19244

SPACELAB'S ROLE IN FUTURE PLATFORM CONCEPTS [SPACELAB'S ROLLE IN ZUKUENFTIGEN PLATTFORMKONZEPTIONEN]

W WIENSS (ERNO Raumfahrttechnik GmbH, Bremen, West Germany) (Herman-Oberth Gesellschaft, Raumfahrtkongress, 31st, Bremen, West Germany, Sept 16-19, 1982) Astronautik, vol 20, no 4, 1982, p 102-108 In German

An attempt is made to develop a scenario for a space platform using the experience gained in the Spacelab program and available Spacelab components, particularly the module, palette, and the Science and Application Space Platform The proposed evolutionary program starts with the small European EURECA platform and finishes with a larger, EUROS-type platform, showing the intermediate steps The various parts of the platforms are illustrated, and their characteristics are presented, including output, mass, and volume The reference mission requirements whose fulfillment will determine space platform parameters are given, and a flow diagram presents proposals for European-American cooperation in building platforms C D

A83-19245

EURECA -A EUROPEAN FREE-FLOATING PLATFORM [EURECA - EINE EUROPAEISCHE FREIFLIEGENDE PLATTFORM]

K HOCHGARTZ (ERNO Raumfahrttechnik GmbH, Bremen, West Germany) (Herman-Oberth Gesellschaft, Raumfahrtkongress, 31st, Bremen, West Germany, Sept 16-19, 1982) Astronautik, vol 20, no 1, 1983, p 5-13 In German

The planning and execution of the EURECA program is addressed The chief goals of the program are stated, and its basic concept is summarized Aspects of load are considered, including those of microgravity and temperature The reference live loads are shown, and possible configurations for the pallette and SPAS components are depicted EURECA's performance data are listed, including electric capacity, positioning action, data transmission temperature regulation, and operation time Mission factors are discussed, showing the mission profile obtained for average sun maximum EURECA subsystems and sub-subsystems are described and graphically shown The output assignments for various subsystems are given, and the principle of the temperature control system is shown Finally, the timetable for the program is addressed C D

A83-20463

THE DEVELOPMENT OF A PRECISION COMPOSITE SPACECRAFT ANTENNA REFLECTOR

J POKRAS and J W SMALL (Hughes Aircraft Co , Space and Communications Group, El Segundo, CA) In National SAMPE Symposium and Exhibition, 27th, San Diego, CA, May 4-6, 1982, Proceedings Azusa, CA, Society for the Advancement of Material and Process Engineering, 1982, p 529-539

(Contract F04701-79-C-0061)

The precision antenna reflector in the Special Sensor Microwave Imager (SSM/I) portion of the Defense Meteorological Satellite Program is used to measure microwave energy from the earth's surface and atmosphere The mission is concerned with the frequency range from 19 to over 87 GHz Surface contour accuracy requirements concerning the parabolic antenna reflector are very severe The weighted rms surface distortion from all error sources was limited to 0 0020 inch To date, three flight reflectors have been fabricated and have completed mechanical and electrical tests Weighted rms surface distortion has been less than 0 0015 inch, and RF performance, the best indicator of accuracy, has been excellent Attention is given to the design configuration, the conducted analysis, aspects of laminate development and testing, reflective surface development, tooling, reflector layup and assembly, and the measurement and test program G R

A83-23682

ORBITAL RING SYSTEMS AND JACOB'S LADDERS. II

P BIRCH British Interplanetary Society, Journal (Interstellar Studies), vol 36, Mar 1983, p 115-128 refs

Engineering, logistics, and safety considerations involved in the development of an orbital ring system (ORS) in LEO for lifting payloads to space on a Jacob's ladder are discussed The massive ring would be everywhere in free fall, and would support hollow or solid elevators extending to the earth's surface and attached by skyhooks to the ORS Payloads would be propelled up hollow tethers by mass drivers, while passenger vehicles moved up the outside of the elevator The physical and operational parameters of the skyhooks and ladders are calculated, together with the projected system costs Consideration is also given to building an initial ring around the moon to haul up material for construction of the earth ORS A partial ORS (PORS) is suggested as an initial step to lower costs, with the cables being lifted partway by balloon and then hauled up by winch to the PORS Risks associated with potential ladder collapse, rupture of the ORS by meteor collision, failure of the superconducting magnet-equipped skyhooks, or load imbalances on the ORS are explored The ORS would necessitate the development of a space colony of a million inhabitants, and would provide investment housing for the ORS developers and users M S K

A83-24177#

THE CONCEPT OF A RETRIEVABLE MICROGRAVITY PLATFORM [DAS KONZEPT EINER 'RETRIEVABLE MICROGRAVITY PLATFORM']

E ACHTERMANN (Dornier System GmbH, Friedrichshafen, West Germany) Deutsche Gesellschaft fuer Luft- und Raumfahrt, Jahrestagung, Stuttgart, West Germany, Oct 5-7, 1982, 11 p In German

(DGLR PAPER 82-063)

The retrievable microgravity platform of the EURECA project and its working load are discussed The hardware is described, especially that used in the solar generator and the propulsion system The platform consists of a unit structure, which helps to hold down costs The heat budget is separate and autonomous, permitting increased flexibility in the choice and organization of the working load The system requires extensive installation of regulated heat pipes and heat pipe radiators Data processing and telemetry are specially adapted for controlling and steering during orbital flight, positioning, and docking The proposed MSF nuclear working load contains smelting ovens and an automatic sample changer C D

A83-24357*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
SYSTEMS AND OPERATIONS - LIVING WITH COMPLEXITY AND GROWTH
W R HOOK (NASA, Langley Research Center, Hampton, VA) Astronautics and Aeronautics, vol 21, Mar 1983, p 53-55

Since the space station concept currently being developed by NASA calls for system updates and additions over a period of at least ten years following launch, attention must be given to the interfaces between station elements Efforts have begun to develop generic fault detection, isolation, and correction techniques that could simplify on-orbit operations, maintenance and repair An integrated hydrogen-oxygen system has been identified as the feature promising the greatest reduction in resupply costs Scavenging excess fuel from the Space Shuttle's internal and external tanks, and using leftover Shuttle payload for fluid tankage, could supply hydrogen and oxygen for consumption in the form of propellants, fuel cell electricity, and life support gases Advancements in cryogenic fluid management and storage technology are the keys to the design of this integrated system Attention is given to the Interactive Design and Evaluation of Advanced Spacecraft computer-aided design and analysis system, which allows system engineers to study the integration problems presented by 40 technical modules O C

A83-24361*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
STRUCTURES AND MECHANISMS - STREAMLINING FOR FUEL ECONOMY
M F CARD (NASA, Langley Research Center, Hampton, VA) Astronautics and Aeronautics, vol 21, Mar 1983, p 66-68

The design of prospective NASA space station components which inherently possess the means for structural growth without compromising initial system characteristics is considered In structural design terms, space station growth can be achieved by increasing design safety factors, introducing dynamic isolators to prevent loads from reaching the initial components, or preplanning the refurbishment of the original structure with stronger elements Design tradeoffs will be based on the definition of on-orbit loads, including docking and maneuvering, whose derived load spectra will allow the estimation of fatigue life Improvements must be made in structural materials selection in order to reduce contamination, slow degradation, and extend the life of coatings To minimize on-orbit maintenance, long service life lubrication systems with advanced sealing devices must be developed O C

A83-26599
SPOT COMMUNICATION AND DATA HANDLING CONCEPT
M ARNAUD (Centre National d'Etudes Spatiales, Toulouse, France) and J P RUFFIE (Matra, S A , Toulouse, France) In Control science and technology for the progress of society, Proceedings of the Eighth Triennial World Congress, Kyoto, Japan, August 24-28, 1981 Volume 4 Part B Oxford, Pergamon Press, 1982, p 2337-2342

The SPOT system comprises an orbital platform with payload and a ground-based system consisting of a telemetry data image processing facility and a control facility The platform incorporates a service module containing power supply, attitude and orbit control, and data management A solar array generates power for the satellite, and a propulsion module containing tanks and thrusters is employed for maneuvering The first of the SPOT payloads will be dedicated to earth observation and will comprise two high resolution visible range radiometers and their associated data processing and telemetry equipment These radiometers employ CCD focal plane detectors Attention is given to SPOT reconfiguration and fault tolerance concepts O C

A83-27500*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
HISTORICAL REVIEW AND CURRENT PLANS
W R HOOK (NASA, Langley Research Center, Space Systems Div , Hampton, VA) American Society of Mechanical Engineers, Winter Annual Meeting, Phoenix, AZ, Nov 14-19, 1982, Paper 15 p refs

A space station concept published in Colliers Magazine in 1952 was the result of a proposal made by a group of visionary scientists and engineers NASA began studies regarding the concepts and technology needed for a space station in 1959 during its first year of existence Formative studies regarding the design and the construction of a space station are discussed, taking into account the 1960 space station design of an American aerospace company, the scale model of a hexagonal self-deploying space station, the concept of the Manned Orbiting Research Laboratory (MORL), MORL with Apollo Logistics System, the MORL Brayton Cycle power system, MORL with nuclear power, a manned orbiting telescope, the 1967 Large Space Station concept, the phase B modular space station, the MOSC configuration 1975, a basic manned platform with resupply, and a concept for a space operations center studied in 1979 A Soviet space station program began with Salyut 1 in April 1971 The U S Skylab was launched in May 1973 Attention is also given to military stations and current planning G R

A83-27768* California Univ , San Diego
THE PINHOLE/OCCULTER FACILITY
H S HUDSON (California, University, San Diego, CA) (COSPAR and International Astronomical Union, Symposium on Advanced Space Instrumentation in Astronomy, 4th, Ottawa, Canada, May 20-22, 1982) Advances in Space Research, vol 2, no 4, 1982, p 307-314 refs
(Contract NSG-7161)

The Pinhole/Occulter Facility concept uses a remote occulting mask to provide high resolution observations of the solar corona and of astronomical X-ray sources With coded-aperture and Fourier-transform techniques, the Pinhole/Occulter makes images at a resolution of 0 2 arc sec for 2-120 keV X-rays, using a 50-m boom erected from the payload bay of the Space Shuttle or mounted on a free-flying platform The remote occulter also creates a large shadow area for solar coronal observations, the Pinhole/Occulter concept includes separate optical and ultraviolet telescopes with 50-cm apertures These large telescopes will provide a new order of resolution and sensitivity for diagnostic observations of faint structures in the solar corona The Pinhole/Occulter is a powerful and versatile tool for general-purpose X-ray astronomy, with excellent performance in a broad spectral band complementary to that accessible with AXAF The large collecting area of 1 5 sq m results in a 5 sigma detection threshold of about 0 02 microJy for the 2-10 keV band (Author)

A83-28184
HIGH STABILITY COMMUNICATIONS HARDWARE FOR SPACECRAFT
J F CLEMMET (British Aerospace, Space and Communications Div , Stevenage, Herts , England) Aerospace Dynamics, Sept 1982, p 25-28

While the dimensional accuracies specified for existing high gain satellite antennas can be achieved through a combination of materials selection and design and fabrication techniques, antenna designs currently under development, including those intended for direct broadcast TV, require a further extension of these capabilities Feed component sophistication will increase, and beam apertures more than 3 m in diameter will be necessary In order to achieve the latter, folding petal and unfurlable mesh antenna configurations are under development Existing and proven technologies are being incorporated into the design of the Large European Communications Satellite payload, which will offer TV broadcasting, 20/30 GHz telephony, and business-related data services O C

A83-28219#

A GEOSTATIONARY SATELLITE PLATFORM FOR FUTURE COMMUNICATIONS SERVICES [EINE GEOSTATIONAEARE SATELLITE-PLATTFORM FUER KUENFTIGE NACHRICHTENDIENSTE]

D E KOELLE (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Luft- und Raumfahrt, vol 4, 1st Quarter, 1983, p 11-14 In German

In connection with the continuously increasing demands for the services provided by geostationary satellites, approaches are being considered for enhancing the capability of the communications satellites The next stage of development will involve the use of multipurpose platforms with weights in the range from 3000 to 5000 kg The reasons for the contemplated augmentation in satellite weight are related to increases in the number of channels needed, the desirability of longer operational lifetimes for satellites, the limited capacity of the geostationary orbit for satellites, and the reduction in cost per channel achievable in connection with increasing satellite size The maximum admissible satellite size depends on the capacity of the available launch vehicles In connection with the decision to develop the Centaur vehicle, it can be expected that after 1986 it will be possible to place into geostationary orbit satellites with a maximum weight of 4,500 kg G R

A83-28414*

SPACE PLATFORMS

,Spaceflight, vol 25, Apr 1983, p 132-134

The expanded scientific capabilities available by interfacing an orbital, free-flying experiments platform with Shuttle tending are outlined The platform would be lifted to orbit by the Shuttle, and modularly increased in size on subsequent flights Science packages could be left on the 26,000 lb space platform for up to six months Component sections would include electrical and thermal control systems, berthing ports for payloads and an Orbiter, and an attitude control, communications, and data handling subsection A 12 kW solar array would furnish power, and interconnect with Spacelab would further enhance the operations range All berthed science packages would have individual pointing ability and grapples for the Orbiter RMS Eventual evolution to include facilities for a human crew and a 25 kW solar array is projected M S K

A83-28692*# National Aeronautics and Space Administration, Washington, D C

TETHERS OPEN NEW SPACE OPTIONS

I BEKEY (NASA, Office of Space Flight, Washington, DC) Astronautics and Aeronautics, vol 21, Apr 1983, p 32-40 refs

Several examples of possible applications of the tethering concept in space are examined In particular, attention is given to a practical design of a 500-kg satellite system to be tethered at a distance of 100 km from the Space Shuttle The satellite body has the form of a sphere, aerodynamically stabilized and fitted with a dockline adapter that mates with a capture mechanism at the tip of an extendable boom, the tether is a very flexible synthetic line 1-2 mm in diameter Other applications include a wholly passive stable platform created by tethering two rows of empty Shuttle External Tanks or similar masses 10-20 km apart, a remote docking port for a space station, and constellations of space objects, with tethers used to tie them together and constrain their relative motions V L

A83-29457

ORBITAL RING SYSTEMS AND JACOB'S LADDERS. III

P BIRCH (Marconi Space and Defence Systems, Ltd, Stanmore, Middx, England) British Interplanetary Society, Journal (Interstellar Studies) (ISSN 0007-084X), vol 36, May 1983, p 231-238 refs

A method for transferring payloads into space without using rockets is considered The method makes use of a massive ring in low earth orbit A comparatively short cable from the ring to the ground (called a Jacob's Ladder) is suspended from a 'Sky Hook' The skyhooks and ladders are geostationary, but the orbital ring is moving at slightly more than orbital velocity The complete 'Orbital Ring System' (ORS) appears to be within reach of present-day technology Part I of this study was devoted to the theoretical aspects of the ORS, while Part II was concerned with aspects of engineering and safety The present investigation is the third part of the study It is concerned with problems of providing power from space, taking into account solar power obtained from high or geosynchronous orbit, power from gravitational energy, an earth orbit light-sail windmill, and a solar orbit light-sail windmill Further uses of orbital ring systems are related to space platforms, super-Jovian planets, and super-stellar planets G R

A83-29731*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

COMPARATIVE ANALYSIS OF LARGE ANTENNA SPACECRAFT USING THE IDEAS SYSTEM

L B GARRETT and M J FEREBEE, JR (NASA, Langley Research Center, Space Systems Div, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 19-28 refs

(AIAA 83-0798)

A Land Mobile Satellite System (LMSS), capable of providing mobile communications for commercial and government applications in nonmetropolitan areas of the continental U S and Canada as an augmentation to existing and planned terrestrial systems, is being studied The satellite system would provide 'narrow band' telecommunications services such as mobile radio, telephone, dispatch, safety, and special radio services, and thin-route fixed telephone and data services in the 806-890 MHz band and continuous emergency beacon monitoring in the 406-406 1 MHz band A single Shuttle launch with an upper stage orbital transfer system would place the LMSS spacecraft in geosynchronous orbit over the continental U S in 1995 with a 10-year lifetime The present investigation has the objective to evaluate, compare, and rank selected spacecraft concepts, to suggest design improvement to the individual concepts, and to identify technology needs G R

N83-10848*# Massachusetts Inst of Tech, Cambridge Artificial Intelligence Lab

SPACE APPLICATIONS OF AUTOMATION, ROBOTICS AND MACHINE INTELLIGENCE SYSTEMS (ARAMIS). VOLUME 2: SPACE PROJECTS OVERVIEW Final Report

R H MILLER, M L MINSKY, and D B S SMITH Aug 1982 182 p

(Contract NAS8-34381)

(NASA-CR-162080-VOL-2, NAS 1 26 162080-VOL-2, SSL-22-82-VOL-2) Avail NTIS HC A09/MF A01 CSCL 09B

Applications of automation, robotics, and machine intelligence systems (ARAMIS) to space activities, and their related ground support functions are studied so that informed decisions can be made on which aspects of ARAMIS to develop The space project breakdowns, which are used to identify tasks ('functional elements'), are described The study method concentrates on the production of a matrix relating space project tasks to pieces of ARAMIS S L

N83-11154*# TRW Defense and Space Systems Group, Redondo Beach, Calif Attached Shuttle Payloads Organization

MATERIALS EXPERIMENT CARRIER CONCEPTS DEFINITION STUDY. VOLUME 1: EXECUTIVE SUMMARY, PART 2 Final Report

17 Dec 1981 61 p refs 3 Vol

(Contract NAS8-33688)

(NASA-CR-170644, NAS 1 26 170644, MPS 6-81-221-VOL-1-PT-2) Avail NTIS HC A04/MF A01 CSCL 22A

The materials experiment carrier (MEC) is an optimized carrier for near term and advanced materials processing in space (MPS) research and commercial payloads When coupled with the space platform (SP), the MEC can provide the extended duration, high power and low acceleration environment the MPS payload typically requires The lowest cost, technically reasonable first step MEC that meets the MPS program missions objectives with minimum programmatic risks is defined The effectiveness of the initial MEC/space platform idea for accommodating high priority, multidiscipline, R&D and commercial MPS payloads, and conducting MPS payload oprations at affordable funding and acceptable productivity levels is demonstrated S L

N83-11155*# TRW Defense and Space Systems Group, Redondo Beach, Calif Attached Shuttle Payloads Organization
MATERIALS EXPERIMENT CARRIER CONCEPTS DEFINITION STUDY. VOLUME 2: TECHNICAL REPORT, PART 2 Final Report
17 Dec 1981 276 p refs 3 Vol
(Contract NAS8-33688)
(NASA-CR-170645, NAS 1 26 170645, MPS 6-81-222-VOL-2-PT-2)
Avail NTIS HC A13/MF A01 CSCL 22A
A materials experiment carrier (MEC) that provides effective accommodation of the given baseline materials processing in space (MPS) payloads and demonstration of the MPS platform concept for high priority materials processing science, multidiscipline MPS investigations, host carrier for commercial MPS payloads, and system economy of orbital operations is defined The study flow of task work is shown Study tasks featured analysis and trades to identify the MEC system concept options S L

N83-11156*# TRW Defense and Space Systems Group, Redondo Beach, Calif
MATERIALS EXPERIMENT CARRIER CONCEPTS DEFINITION STUDY. VOLUME 3: PROGRAMMATICS, PART 2
17 Dec 1981 29 p refs 3 Vol
(Contract NAS8-33688)
(NASA-CR-170646, NAS 1 26 170646, MPS 6-81-223-VOL-3-PT-2)
Avail NTIS HC A03/MF A01 CSCL 22A
Project logic, schedule and funding information was derived to enable decisions to be made regarding implementation of MEC system development A master schedule and cost and price estimates (ROM) were developed for a project that consists of development of an all-up MEC, its integration with payloads and its flight on one 90 day mission In Part 2 of the study a simple initial MEC was defined to accommodate three MPS baseline payloads The design of this initial MEC is illustrated The project logic, detailed schedules, and ROM cost estimate relate to a project in which this initial MEC is developed, integrated with payloads and flown once for 180 days S L

N83-11192*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala Space Platform Project
SPACE PLATFORM
G BEAM *In* NASA Johnson Space Center Satellite Serv Workshop, Vol 1 p 320-334 1982
Avail NTIS HC A20/MF A01 CSCL 22A
The space platform subsystem design characteristics are described in detail Compatibility with the STS/orbiter is an important factor B W

N83-14156# R and D Associates, Arlington, Va
RESEARCH NEEDS: PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS Final Report, 26 Oct. 1981 - 31 Jul. 1982
P J TURCHI Jun 1982 100 p refs
(Contract F49260-82-C-0008, AF PROJ 2308)
(AD-A119243, AFOSR-82-0717TR) Avail NTIS HC A05/MF A01 CSCL 10B
By the year 2000, an increasingly large portion of our national defense will depend on space-based systems As part of a broader set of new research initiatives in support of space systems, the Air Force Office of Scientific Research is sponsoring basic research that may be applicable to the development of megawatt-level space prime-power systems (The emphasis of this particular new initiative is prime-power versus pulsed power including power conditioning, such as fly-wheel or inductive storage, for which there are existing programs) To assist AFOSR, R and D Associates organized a special conference on prime-power for high-energy space systems, compiled the proceedings of the conference, and provided a review document identifying basic research areas in support of future space prime-power development This document is the Appendix of the present report The intent has been to focus on basic vs applied research and to provide guidance and assistance to prospective researchers In this last regard, a bibliography of space prime-power is contained in the appended document
Author (GRA)

N83-14722*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
NASA SOLAR ARRAY FLIGHT EXPERIMENT Progress Report
G TURNER (LMSC, Sunnyvale, Calif) and H HILL *In* ESA Photovoltaic Generators in Space p 179-184 Jun 1982
Avail NTIS HC A15/MF A01
The NASA large flexible solar array space shuttle flight experiment is described The 32 x 4 m wing is deployed from the shuttle bay, and experiments in electrical output, multiple deployment, and structural dynamics are planned Both 2 x 4 cm and 5 9 x 5 9 cm cell assemblies on the array blanket are evaluated Safety/hazards provisions are described, including emergency jettison provisions Ground testing and hardware fabrication are summarized Author (ESA)

N83-14730# AEG-Telefunken, Wedel (West Germany)
THE DESIGN OF THE L-SAT SOLAR ARRAY
L GERLACH, G W MARKS (Spar Aerospace Ltd , Toronto), E QUITTNER (Spar Aerospace Ltd , Toronto), J RENSHALL (Spar Aerospace, Ltd , Toronto), and R SWANENBURG (Royal Netherlands Aircraft Factories Fokker, Amsterdam) *In* ESA Photovoltaic Generators in Space p 241-255 Jun 1982 refs
Avail NTIS HC A15/MF A01
The concept, requirements, mission phases, design, analyses, and testing of a large, modular, deployable, flexible/foldable blanket, Sun tracking solar array are described The same design is capable of providing 1 9 kW to 6 5 kW end-of-10 yr geosynchronous equinox power per spacecraft by simple modular changes, with further growth to 7 8 kW by means of structral modifications The array undergoes partial deployment after insertion into the transfer orbit to develop 3 kW minimum and is fully deployed after apogee engine firing Author (ESA)

N83-16861# R and D Associates, Arlington, Va
RESEARCH NEEDS: PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS Final Report, 26 Oct 1981 - 31 Jul. 1982
P J TURCHI Jul 1982 100 p refs
(Contract F49620-82-C-0008, AF PROJ 2301)
(AD-A120209, RDA-TR-120900-001, AFOSR-82-0875TR) Avail NTIS HC A05/MF A01 CSCL 22B
By the year 2000, an increasingly large portion of our national defense will depend on space-based systems As part of a broader set of new research initiatives in support of space systems, the Air Force Office of Scientific Research is sponsoring basic research that may be applicable to the development of megawatt-level space prime-power systems The emphasis of this particular new initiative is prime-power versus pulsed power including power conditioning, such as flywheel or inductive storage, for which there are existing programs GRA

N83-18836*# L'Garde, Inc , Newport Beach, Calif
INITIAL '80S DEVELOPMENT OF INFLATED ANTENNAS Final Report
G J FRIESE, G D BILYEU, and M THOMAS Jan 1983 104 p refs
(Contract NAS1-16663)
(NASA-CR-166060, NAS 1 26 166060, LTR-82-GF-107) Avail NTIS HC A06/MF A01 CSCL 22B
State of the art technology was considered in the definition and documentation of a membrane surface suitable for use in a space reflector system for long durations in orbit Requirements for a metal foil-plastic laminate structural element were determined and a laboratory model of a rigidized element to test for strength characteristics was constructed Characteristics of antennas

ranging from 10 meters to 1000 meters were determined The basic antenna configuration studied consists of (1) a thin film reflector, (2) a thin film cone, (3) a self-rigidizing structural torus at the interface of the cone and reflector, and (4) an inflation system The reflector is metallized and, when inflated, has a parabolic shape The cone not only completes the enclosure of the inflatant, but also holds the antenna feed at its apex The torus keeps the inflated cone-reflector from collapsing inward Laser test equipment determined the accuracy of the inflated paraboloids A R H

N83-20360*# Rockwell International Corp , Pittsburgh, Pa Satellite Systems Div
LOW CONCENTRATION RATION SOLAR ARRAY FOR LOW EARTH ORBIT MULTI-100 KW APPLICATION Mid-term Report
S J NALBANDIAN Nov 1982 146 p refs
(Contract NAS8-34214)
(NASA-CR-170729, NAS 1 26 170729, SSD82-0172) Avail NTIS HC A07/MF A01 CSCL 10A

An ongoing preliminary design effort directed toward a low-concentration-ratio photovoltaic array system based on 1984 technology and capable of delivering multi-hundred kilowatts (300 kW to 1000 kW range) in low earth orbit is described The array system consists of two or more array modules each capable of delivering between 80 kW to 172 kW using silicon solar cells or gallium arsenide solar cells respectively The array module deployed area is 1320 square meters and consists of 4356 pryamidal concentrator elements The module, when stowed in the Space Shuttle's payload bay, has a stowage volume of a cube with 3 24 meters on a side The concentrator elements are sized for a geometric concentration ratio (GCR) of six with an aperture area of 0 5 meters x 0 5 meters The structural analysis and design trades leading to the baseline design are discussed The configuration, as well as optical, thermal and electrical performance analyses that support the design and overall performance estimates for the array are described Author

N83-20877*# National Aeronautics and Space Administration, Washington, D C
SPACE TELESCOPE
J J MCROBERTS Feb 1982 64 p Original doc contains color illustrations
(NASA-EP-166, NAS 1 19 166) Avail NTIS HC A04/MF A01 CSCL 03A

The Space Telescope is discussed The spacecraft, science instruments, deployment, the Space Telescope Science Institute, and astronomy are discussed Author

N83-20976# MATRA Espace, Paris-Velizy (France)
ADAPTATION OF THE MULTIMISSION PLATFORM/(PFM) FOR THE ERS MISSION. PART 1: PFM MISSION LIFETIME EXTENSION TO THREE YEARS Final Report
J M DARROY Paris ESA 19 Apr 1982 121 p *In* FRENCH, ENGLISH summary 4 Vol
(Contract ESA-4812/81/DD(SC))
(DM-51/JMD/MA/506 81, ESA-CR(P)-1675-VOL-1) Avail NTIS HC A06/MF A01

The multimission platform is described and its reliability requirements for the SPOT project are reviewed The status of reliability analysis for a 2-year mission is discussed as well as reliability assessment for a 3-year ERS mission Failure modes, critical items, and lifetime and reliability limitations are examined to determine the risks involved in using the platform for longer missions Transl by A R H

N83-20977# MATRA Espace, Paris-Velizy (France)
ADAPTATION OF THE MULTIMISSION PLATFORM/(PFM) FOR THE ERS MISSION PART 2: POWER SUBSYSTEM ADEQUACY Final Report
J CORNET, Y DUBOIS, and P LEBLANC Paris ESA 9 Aug 1982 125 p refs 4 Vol
(Contract ESA-4812/81/DD(SC))
(DM-51/JC/JP/0226 82, ESA-CR(P)-1675-VOL-2) Avail NTIS HC A06/MF A01

The ERS mission has high energy requirements and is at the limits of the PFM maximum energy supply capability Topics covered include the payload distribution network, active microwave instrument perturbation, and the hybrid solid state switch The solar array power increase from 1 9 KW to 2 2 KW BOL appears feasible The EBLOS program was used to model the solar array, the battery, the shunt regulator and loads Battery charge control was determined and different power subsystem networks for autonomous charge control of each Ni Cd battery were examined A R H

N83-20978# MATRA Espace, Paris-Velizy (France)
ADAPTATION OF THE MULTIMISSION PLATFORM/(PFM) FOR THE ERS MISSION. PART 3: EFFECTS OF THE SAR AND SCATTEROMETER ANTENNAS Final Report
J CORNET, M AYOUN, M KEREBEL, D PAWLAK, E DUTTO, and J P VORMUS Paris ESA 19 Apr 1982 168 p refs 4 Vol
(Contract ESA-4812/81/DD(SC))
(DM-51E/JC/JP/0039 82, ESA-CR(P)-1675-VOL-3) Avail NTIS HC A08/MF A01

The impacts of the large ERS antennas on multimission platform performances were investigated Results show that a perturbing torque due to the yaw thrusters impingement on the SAR antenna discreases AOCS efficiency in normal mode and implies the non-action of the impinging thrusters in safe mode A move of SAR and scatterometer antenna is recommended A hot spot case was identified in an improbable configuration of the satellite This hot spot case is due to scatterometer antennas shadowing on the solar array A modification by 3 deg of platform temperatures is due to antennas' thermal coupling or shadowing A R H

N83-20979# MATRA Espace, Paris-Velizy (France)
ADAPTATION OF THE MULTIMISSION PLATFORM/(PFM) FOR THE ERS MISSION. PART 4. FEASIBILITY OF SATELLITE ROLL TILTING Final Report
J CORENT, M AYOUN, D PAWLAK, E DUTTO, and J P VORMUS Paris ESA 19 Apr 1982 105 p refs 4 Vol
(Contract ESA-4812/81/DD(SC))
(DM-51E/JC/JP/0053 82, ESA-CR(P)-1645-VOL-4) Avail NTIS HC A06/MF A01

The effects on multimission platform performances of a + or - 20 deg roll tilt of the satellite were studied This tilt would permit SAR operation at different incidence angles for scientific purposes The principal findings show (1) the satellite attitude measurement accuracy is slightly decreased and the AOCS control loops and software must be modified, (2) The TTC link budget remains correct, solar array occultations are changed, (3) the Solar Array power is slightly reduced, and (4) The PFM thermal control has to be adapted if the satellite remains tilted for several orbits A R H

N83-21001# Contraves Corp , Zurich (Switzerland)
STUDY ON LARGE, ULTRA-LIGHT, LONG-LIFE STRUCTURES IN SPACE, PHASE 2 Final Report
M C BERNASCONI, C F VANMANSVELT, J P SCHWANDER, and K J ZIMMERMANN Paris ESA Jul 1982 215 p refs
(Contract ESTEC-4023/79/NL-AK)
(TM-EKR3, ESA-CR(P)-1664) Avail NTIS HC A10/MF A01

The feasibility of inflatable, space rigidized structures (ISRS) was positively assessed and a reference object - a 10 m antenna reflector was designed and subjected to a preliminary analysis The wall of such a chemically rigidizing object is a thin, fiber reinforced composite lamina The search for suitable matrix resins and their characterization and improvement program is disussed

For the reinforcement, a lightweight KEVLAR cloth was chosen - mainly for thermostability reasons The selected matrix is an imide modified, catalytically cured, cycloaliphatic epoxy resin, which can be cured either thermally or by an external gaseous catalyst The area mass of the resulting composite wall - including a plastic foil gas barrier - is of the order of 0 1 kg/m2 sq m The materials were subjected to an extensive series of tests, including thermal cycling, charging, simulated solar exposure, 1 year storage stability and 4 year thermal aging S L

N83-22051*# Jet Propulsion Lab, California Inst of Tech, Pasadena

SUBMILLIMETRE ASTRONOMY FROM SPACE PLATFORMS

T B H KUIPER and D J HOLLENBACH (NASA Ames Research Center) *In* ESA The Sci Importance of Submillimetre Observations ap 91-96 Aug 1982 refs

Avail NTIS HC A11/MF A01 CSCL 03A

The scientific need and the technical feasibility of a 10-m class far infrared telescope in space were studied and culminated in the recommendation of the large deployable reflector (LDR) The scientific considerations for such a project are described and the general characteristics of LDR are derived A scientific program culminating in LDR is suggested E A K

N83-22053*# Jet Propulsion Lab, California Inst of Tech, Pasadena

A CONCEPT FOR AN ORBITING SUBMILLIMETRE-INFRARED OBSERVATORY

P N SWANSON and M KIYA (NASA Ames Research Center) *In* ESA The Sci Importance of Submillimetre Observations p 99-105 Aug 1982 refs

(Contract NAS7-100)

Avail NTIS HC A11/MF A01

A large submillimeter and far infrared orbiting astronomical observatory were designed The operating wavelength will be between 1 mm (1000 micro m) and 30 micro m The short wavelength limit is a compromise between the point where smaller, cooled telescopes become more sensitive and practical technology The short wavelength limit may be increased if the tradeoff between cost and scientific return is advantageous E A K

N83-22270*# Draper (Charles Stark) Lab, Inc, Cambridge, Mass

A PROGRAM PLAN FOR THE DEVELOPMENT OF FAULT TOLERANT LARGE SPACE SYSTEMS

P MOTYKA *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 175-180 Apr 1983

Avail NTIS HC A12/MF A01 CSCL 22B

The need for fault tolerance in Large Space systems is discussed The unique characteristics of LSS which affect fault tolerance are described The status of fault tolerant research for LSS is described A program plan to validate and demonstrate the concept of fault tolerance for LSS is developed B W

03

STRUCTURAL CONCEPTS

Includes erectable structures (joints, struts, and columns), deployable platforms and booms, solar sail, deployable reflectors, space fabrication techniques, and protrusion processing

A83-12753

REFINED DESIGN OF SELF-EXPANDING STAYED COLUMN FOR USE IN SPACE

F W WILLIAMS, J R BANERJEE, S R HARRIS, and M W N HUGHES (University of Wales Institute of Science and Technology, Cardiff, Wales) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct 4-7, 1982) Computers and Structures, vol 16, no 1-4, 1983, p 353-360 Research supported by the Science Research Council refs

The type of stayed column considered was developed by the ASTRO Research Corporation for NASA to evaluate, and is designed to be deployed in space after forming a light, compact package in the Space Shuttle It consists of a core with three identical stay frames equally spaced around it Each stay frame has a central compressed spoke with pretension stays which radiate from its end to the core Three pretensioned battens connect the ends of the spokes This paper refines, extends and discusses the original design method to give significantly lighter and compacter packages for the Space Shuttle, a better understanding of how such columns behave, many more results than hitherto, and arguments for simplifying construction, packaging and deployment by omitting the battens (Author)

A83-16811#

THE CONSTRUCTION OF TEN-FOOT LONG COMPOSITE SPACE TUBES

S C NOLET (MIT, Cambridge, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 10 p

(AIAA PAPER 83-0644)

A system has been developed in the Technology Laboratory for Advanced Composites at MIT for the construction of ten-foot long, four-inch diameter composite tubes Conventionally, composites are cured under high temperature and pressure inside an autoclave The system developed here, cures composite materials on an internally-heated expandable rubber mandril enclosed in a vacuum, thus an autoclave is not required to cure the material with this apparatus The design and construction of the apparatus is described Five graphite-glass/epoxy tubes and three graphite/epoxy tubes were constructed Uneven heat distribution exists over the surface of the mandril which may result in an incomplete cure of the epoxy resin in parts of the tube Also, surface imperfections such as wrinkles are present in most tubes Modifications to the existing apparatus such as increased heating capabilities and better temperature control, and the introduction of a brass sheet around the composite to reduce surface flaws are suggested The tubes have been used as structural components in a mockup of a space structure (Author)

A83-27248* Astro Research Corp, Carpinteria, Calif

STACBEAM - AN EFFICIENT, LOW-MASS, SEQUENTIALLY DEPLOYABLE STRUCTURE

L R ADAMS (Astro Research Corp, Carpinteria, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1578-1583

(Contract NAS7-100)

Design features of the stacking triangular articulated compact beam (Stacbeam) as a candidate truss structure for GEOS spacecraft solar power arrays are explored Solar arrays of increasing size require folding, noninterfering structures, minimal thermal effects, slow and controlled deployment, and a high aspect ratio The Stacbeam consists of a triangular batten frame perpendicular to the beam axis, three longerons attached at the corners of the batten frame and mounted parallel to the beam axis, and three diagonals to provide shear and torsional stiffness Locking hinges are installed at the midpoint and ends of each longeron and at the midpoint and ends of each diagonal The material is graphite/epoxy composite with a 120 GPa modulus and a 1500 kg/sq m density Successful vertical deployment on the ground has been effected with a prototype deployer, together with horizontal cantilever in a fully deployed configuration

M S K

A83-29739#
OPTIMIZATION OF PARABOLIC BOX TRUSS REFLECTOR STRUCTURES
J V COYNER, JR and J J HERBERT (Martin Marietta Aerospace, Denver, CO) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 107-116
(AIAA 83-0830)

This paper addresses methods of designing and optimizing space structures to maximize dynamic performance, minimize effects of temperature variations during space operations, minimize loads produced by manufacturing length errors in truss members, minimize weight, and produce a structure that stows in the smallest possible volume for Space Shuttle transport Results of typical structural optimizations are also presented Truss member properties are optimized for their thermoelastic behavior, manufacturing inaccuracies, dynamic performance, strength, and packaging

Author

A83-29781#
PRESTRESSED GEODESIC 3-NETS
E N KUZNETSOV (Illinis, University, Urbana, IL) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 528-533 refs
(Contract NSF CEE-82-12099)
(AIAA 83-0972)

A structural system under consideration is formed by three intersecting arrays of linear members such that every intersection involves three members (one from each array) If the intersections are not fixed, the system is underconstrained and, generally, does not have a unique configuration However, underconstrained systems allow exceptional configurations in which they lack mobility and admit prestress determined by their geometry The objective of this study is to synthesize an immobile (static) axisymmetric 3-net wherein all three arrays are geodesic The entire class of such nets is identified and their interrelated statical and geometric properties revealed

Author

N83-11158*# Grumman Aerospace Corp, Bethpage, N Y
SPACE FABRICATION DEMONSTRATION SYSTEM COMPOSITE BEAM CAP FABRICATOR Final Report
Mar 1982 67 p
(Contract NAS8-32472)
(NASA-CR-170642, NAS 1 26 170642) Avail NTIS HC A04/MF A01 CSCL 22A

A detailed design for a prototype, composite beam cap fabricator was established Inputs to this design included functional tests and system operating requirements All required materials were procured, detail parts were fabricated, and one composite beam cap forming machine was assembled The machine was demonstrated as a stand-alone system Two 12-foot-long beam cap members were fabricated from laminates graphite/polysulfane or an equivalent material One of these members, which as structurally tested in axial compression, failed at 490 pounds

M G

N83-14305*# Grumman Aerospace Corp, Bethpage, N Y
COMPOSITE BEAM CAP FABRICATOR EXPERIMENT DEFINITION STUDY, VOLUME 1 Final Report
23 Jul 1982 151 p refs 2 Vol
(Contract NAS8-32472)
(NASA-CR-170688, NAS 1 26 170688) Avail NTIS HC A08/MF A01 CSCL 13H

The Composite Beam Cap Fabricator (CBCF), a part of a family of machines that was designed to develop and augment the technology of space fabrication (the automatic production of basic structural members in space is described The major components of the CBCF are described The mill weighs approximately 1400 pounds and its size is approximately 6 feet by 2 feet by 2 feet It is a microprocessor under a low cost-of-concept type of contract Consequently, all components are made of commercially available hardware Neither weight nor volume constraints were considered during the development of the machine For example, over 3/4 of the volume enclosed by the controller units is empty

R J F

N83-14725# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost Space Div
EXTENDIBLE AND RETRACTABLE MASTS FOR SOLAR ARRAY DEVELOPMENTS
A M V VIELEERS and P R PREISWERK (Astro Research Corp) *In* ESA Photovoltaic Generators in Space p 201-207 Jun 1982 refs
Avail NTIS HC A15/MF A01

The Astromast instrument boom, and its applications in European and American space programs (e g, L-Sat, Voyager) are described In the continuous version the longitudinal beams (longerons) are elastically coiled when in their stowed configuration In the articulated version the longerons are segmented and hinged, and are folded when in stowed configuration For fully automated array deployment, the Astromast provides actuation and drive for articulations of the stowage boxes from their stowed position to the array deployment position, actuation and drive for release and reapplication of blanket preload pressure, and deployment and retraction of the solar array wing

Author (ESA)

N83-15346*# Vought Corp, Dallas, Tex
DEVELOPMENT OF DEPLOYABLE STRUCTURES FOR LARGE SPACE PLATFORM SYSTEMS, PART 1 Interim Report, 29 Oct. 1981 - 31 Jul. 1982
R L COX and R A NELSON 25 Oct 1982 209 p refs
(Contract NAS8-34678)
(NASA-CR-170690, NAS 1 26 170690, REPT-2-32300/2R-53215-PT-1) Avail NTIS HC A10/MF A01 CSCL 22B

Eight deployable platform design objectives were established autodeploy/retract, fully integrated utilities, configuration variability, versatile payload and subsystem interfaces, structural and packing efficiency, 1986 technology readiness, minimum EVA/RMS, and Shuttle operational compatibility

N W

N83-16784*# Astro Research Corp, Carpinteria, Calif
DESIGN CONCEPTS FOR LARGE REFLECTOR ANTENNA STRUCTURES Final Report
J M HEDGEPETH and L R ADAMS Washington NASA Jan 1983 82 p refs
(Contract NAS1-16134)
(NASA-CR-3663, NAS 1 26 3663, ARC-R-1018) Avail NTIS HC A05/MF A01 CSCL 20K

Practical approaches for establishing large, precise antenna reflectors in space are described Reflector surfaces consisting of either solid panels or knitted mesh are considered The approach using a deep articulated truss structure to support a mesh reflector is selected for detailed investigations A new sequential deployment concept for the tetrahedral truss is explained Good joint design is discussed, and examples are described both analytically and by means of demonstration models The influence of curvature on the design and its vibration characteristics are investigated

Author

N83-18813*# Astro Research Corp , Carpinteria, Calif
EFFICIENT STRUCTURES FOR GEOSYNCHRONOUS SPACECRAFT SOLAR ARRAYS, PHASE 4
L R ADAMS 14 Sep 1982 43 p refs Prepared for JPL
(NASA-CR-169906, NAS 1 26 169906, ARC-TN-1112) Avail NTIS HC A03/MF A01 CSCL 22B

Efficient structures for geosynchronous spacecraft solar arrays were investigated The STACBEAM (stacking triangular articulated compact beam) concept was selected The primary component, the solar array blanket, is stored in a folded configuration and is deployed by controlled linear extension Blanket stiffness is attained by axially tensioning the blanket and by providing periodic lateral ribs and standoffs which attach the blanket to the beam at several places along its length The STACBEAM deploys sequentially (one bay at a time) using a deployer of sufficient rigidity so that beam stiffness is not degraded during deployment The beam does not rotate during deployment, thus making blanket beam attachment possible in the packaged condition In addition to high bending stiffness, the STACBEAM possesses high torsional rigidity due to nonflexible diagonals The concept is adaptable to various size and loading requirements by changing member diameter and baylength, thus affecting the ratio of packaged and deployed length S L

N83-18825*# General Electric Co , Philadelphia, Pa Space Systems Div
ANALYSIS AND TESTING OF LARGE SPACE STRUCTURES
C V STAHLE *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 113-122 Feb 1983
Avail NTIS HC A10/MF A01 CSCL 22B

Considerations and approaches to the ground testing of large space structures are discussed The large size combined with the loading due to gravity makes testing of the complete structure difficult Gravitational stiffening, suspension effects, virtual air mass, preloads, and air damping alter the dynamic characteristics Low resonant frequencies and high modal densities within the frequency range of interest combine with small motions and accelerations to make testing difficult Mechanism complexities and nonlinearities associated with space-erected/assembled structures cause structural complexity regardless of other considerations Ground test approaches include scale models, element and substructure tests, and structural linearization Analytical approaches are also discussed M G

N83-18841*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
TECHNICAL SUPPORT PACKAGE: LARGE, EASILY DEPLOYABLE STRUCTURES. NASA TECH BRIEFS, FALL 1982, VOLUME 7, NO. 1
1982 102 p refs
(NASA-TM-85239, MFS-25647, NAS 1 15 85239) Avail NTIS HC A06/MF A01 CSCL 22B

Design and test data for packaging, deploying, and assembling structures for near term space platform systems, were provided by testing light type hardware in the Neutral Buoyancy Simulator An optimum or near optimum structural configuration for varying degrees of deployment utilizing different levels of EVA and RMS was achieved The design of joints and connectors and their lock/release mechanisms were refined to improve performance and operational convenience The incorporation of utilities into structural modules to determine their effects on packaging and deployment was evaluated By simulation tests, data was obtained for stowage, deployment, and assembly of the final structural system design to determine construction timelines, and evaluate system functioning and techniques S L

N83-20157*# National Aeronautics and Space Administration Pasadena Office, Calif
ARTICULATED JOINT FOR DEPLOYABLE STRUCTURES Patent Application
N D CRAIGHEAD (JPL, California Inst of Tech , Pasadena), R J PRELIASCO (JPL, California Inst of Tech , Pasadena), and T D HULT, inventors (to NASA) (JPL, California Inst of Tech , Pasadena) 25 Feb 1983 12 p
(Contract NAS7-100)
(NASA-CASE-NPO-16038-1, US-PATENT-APPL-SN-469864) Avail NTIS HC A02/MF A01 CSCL 13I

A joint is described for connecting a pair of beams to pivot them between positions in alignment or beside one another, which is of light weight and which operates in a controlled manner The joint includes a pair of fittings and at least one center link having opposite ends pivotally connected to opposite fittings and having axes that pass through centerplanes of the fittings A control link having opposite ends pivotally connected to the different fittings controls their relative orientations, and a toggle assembly holds the fittings in the deployed configuration wherein they are aligned The fittings have stops that lie on one side of the centerplane opposite the toggle assembly NASA

N83-20944* National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
ELECTRICAL ROTARY JOINT APPARATUS FOR LARGE SPACE STRUCTURES Patent
R R BELEW and R J BOEHME, inventors (to NASA) 4 Feb 1981 8 p Filed 4 Feb 1981 Supersedes N81-19394 (19 - 10 p 1345)
(NASA-CASE-MFS-23981-1, US-PATENT-4,377,266, US-PATENT-APPL-SN-231543, US-PATENT-CLASS-244-159, US-PATENT-CLASS-322-2R, US-PATENT-CLASS-339-5R, US-PATENT-CLASS-339-3R, US-PATENT-CLASS-343-DIG2, US-PATENT-CLASS-244-173) Avail US Patent and Trademark Office CSCL 21E

A structural array and electrical rotary joint for transmitting an electrical power between large space structures having relative rotational movement is disclosed which includes large support framework structures which rotate relative to one another about a common axis of rotation A rotary interface joint is defined between the structures A cylindrical hub member is carried by one structure and a cylindrical hub member is carried by a support structure with a third hub member being concentrically within a fourth hub member for relative rotation Tension connecting cables connect hub members with their associated outer structures whereby relative rotational movement between the structures is transmitted to the cylindrical hub members for unitary motion therewith Electrical conductor brush members are carried by one hub and electrical contact rings are carried by another hub member in sliding electrical contact with the brushes for transmission of electrical power during relative rotational movement between the two support structures
Official Gazette of the U S Patent and Trademark Office

N83-21000# Aeritalia S p A , Torino (Italy)
OPTIMIZATION OF JOINTS TECHNOLOGY FOR LARGE SPACE PLATFORMS Final Report
G DEMILIANO and E TURCI Paris ESA 30 Apr 1981 345 p refs
(Contract ESTEC-3958/79/NL-AK)
(JO-RP-AI-001, ESA-CR(P)-1644) Avail NTIS HC A15/MF A01

A joint system to be used as the interfacing element in the integration in low Earth orbit of preassemble module structures to form an orbiting platform is discussed A total of requirements for such a joint as can be predicted, from a knowledge of a proposed platform configuration, its performance requirements and the total known or assumed environment on the platform and its component modules in all stages of assembly, as these affect the joint is developed S L

04

STRUCTURAL AND THERMAL ANALYSIS

Includes structural analysis and design, thermal analysis and design, analysis and design techniques, and thermal control systems

A83-12752* National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ON THE ANALYTICAL MODELING OF THE NONLINEAR VIBRATIONS OF PRETENSIONED SPACE STRUCTURES
J M HOUSNER and W K BELVIN (NASA, Langley Research Center, Hampton, VA) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct 4-7, 1982) Computers and Structures, vol 16, no 1-4, 1983, p 339-352 refs

Pretensioned structures are receiving considerable attention as candidate large space structures A typical example is a hoop-column antenna The large number of preloaded members requires efficient analytical methods for concept validation and design Validation through analyses is especially important since ground testing may be limited due to gravity effects and structural size The present investigation has the objective to present an examination of the analytical modeling of pretensioned members undergoing nonlinear vibrations Two approximate nonlinear analysis are developed to model general structural arrangements which include beam-columns and pretensioned cables attached to a common nucleus, such as may occur at a joint of a pretensioned structure Attention is given to structures undergoing nonlinear steady-state oscillations due to sinusoidal excitation forces Three analyses, linear, quasi-linear, and nonlinear are conducted and applied to study the response of a relatively simple cable stiffened structure G R

A83-13147*# University of Southern California, Los Angeles
AN ALGORITHM FOR FINITE ELEMENT ANALYSIS OF PARTLY WRINKLED MEMBRANES
R K MILLER (Southern California, University, Los Angeles, CA) and J M HEDGEPETH (Astro Research Corp, Carpinteria, CA) AIAA Journal, vol 20, Dec 1982, p 1761-1763
(Contract JPL-955873)

A generalization and numerical implementation is presented of the Stein-Hedgepeth (1961) continuum theory for the analysis of partly wrinkled membranes, such as the tensioned membrane surfaces which are found in spacecraft structural components The approach has its basis in experimental observations showing that when wrinkles develop in a membrane parallel to the x direction, the associated overall contraction in the y direction exceeds that predicted by the Poisson's ratio effect O C

A83-16649*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
RADIANT HEATING TESTS OF SEVERAL LIQUID METAL HEAT-PIPE SANDWICH PANELS
C J CAMARDA (NASA, Langley Research Center, Loads and Aeroelasticity Div, Hampton, VA) and A BASIULIS (Hughes Aircraft Co, Dynamics Div, Torrance, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 8 p refs
(AIAA PAPER 83-0319)

Integral heat-pipe sandwich panels, which synergistically combine the thermal efficiency of heat pipes and the structural efficiency of honeycomb sandwich construction, were conceived as a means of alleviating thermal stress problems in the Langley Scramjet Engine Test panels which utilized two different wickable honeycomb cores, facesheets with screen mesh sintered to the internal surfaces, and a liquid metal working fluid (either sodium or potassium) were tested by radiant heating at various heat-load levels The heat-pipe panels reduced maximum temperature differences by 31 percent with sodium working fluid and 45 percent with potassium working fluid Results indicate that a heat-pipe sandwich panel is a potential, simple solution to the engine thermal stress problem Other interesting applications of the concept include cold plates for electronic component and circuit card cooling, radiators for large space platforms, low-distortion large area structures (e g, space antennas) and laser mirrors (Author)

A83-16712#
MECHANICS OF THE FLEXIBLE DIPOLE ANTENNA OF WISP
F RIMROTT (Toronto, University, Toronto, Canada) and F VIGNERON (Department of Communications, Ottawa, Canada) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 12 p Research supported by the National Research Council of Canada refs
(AIAA PAPER 83-0433)

Present concepts for the Waves in Space Plasma (WISP) program call for a dipole antenna system on the Shuttle with a dipole length of 100 m tip-to-tip for the initial misison, while later missions may use larger configurations of up to 300 m tip-to-tip The paper presents a parametric study of the mechanics of the antenna-Shuttle system for configurations between 0 and 300 m tip-to-tip For the study it is assumed that the antennas are booms of silver-plated interlocked BISTEM type of construction, and the range of boom diameters considered is 13 to 50 mm The paper summarizes the static, quasi-static, and dynamic effects, which cause the configuration to deform, outlines approximate analytic formulas that facilitate the determination of the deformations and critical speeds, and presents graphs of quantitative information over the range of parameters (Author)

A83-17436#
ACCELERATED THERMAL CYCLING OF SPACECRAFT SOLAR-CELL MODULES
J C LARUE (ESA, Mechanical Systems Div, Noordwijk, Netherlands) ESA Bulletin, no 32, Nov 1982, p 70-74

ESTEC has accelerated-thermal-cycling facilities designed for testing lightweight solar-cell modules or other spacecraft structural elements with an acceleration factor of 50 compared to low-earth-orbit conditions This article described the operating principles and critical design features of the two facilities (ATC-1 and 2) and recounts some of the test results achieved so far, particularly in relation to solar-cell interconnection problems The performance and economics of the method are compared with those of conventional vacuum thermal cycling (Author)

A83-18226#
LARGE SCALE STRUCTURAL OPTIMIZATION BY FINITE ELEMENTS
C FLEURY (Liege, Universite, Liege, Belgium) In International Symposium on Optimum Structural Design and ONR Naval Structural Mechanics Symposium, 11th, Tucson, AZ, October 19-22, 1981 Tucson, AZ, University of Arizona, 1982, p 11-23 to 11-41 refs

Optimization techniques implemented in SAMCEF, a general purpose finite-element system capable of solving large-scale structural analysis problems (several thousands of degrees of freedom and finite elements), are discussed The optimization module of SAMCEF is built to loop on the general static, dynamic, and stability analysis modules This implies that all the possibilities offered by these modules are still available, as well as those of the auxiliary modules, such as mesh generators, plotting capabilities, and others The optimization strategy involves the conversion of the initial nonlinear programming problem into a sequence of explicit problems of algebraically simple separable form, various primal and dual optimization schemes are available to solve the explicit subproblems Numerical examples are presented for an I-beam, a composite box beam, a sandwich column, and an aircraft spoiler V L

A83-18454* Texas A&M Univ, College Station
PRIMING CONSIDERATIONS OF HEAT PIPES IN ZERO-G
G P PETERSON (Texas A & M University, College Station, TX) In Heat Transfer and Fluid Mechanics Institute, Meeting, 28th, Sacramento, CA, June 28, 29, 1982, Proceedings Sacramento, CA, CSUS University Publications, 1982, p 47-53 refs
(Contract NGT-44-005-115)

Investigations into the forces which govern the geometric configuration of the liquid vapor interface in Grumman's high capacity monogroove Heat Pipe are made Two separate methods are used to determine the time to prime and computer programs using these mathematical techniques are developed and presented A description of the two techniques along with a discussion of the variation of the results follows In addition, experimental procedures for tests designed to verify modeling predictions are described (Author)

A83-23368
STRAIN MONITORING FOR THE SPACE SHUTTLE REMOTE MANIPULATOR SYSTEM
L J WEYMOUTH (Brewer Engineering Laboratories, Inc, Marion, MA) In Measurements in hostile environments, Proceedings of the International Conference, Edinburgh, Scotland, August 31-September 4, 1981 Newcastle-upon-Tyne, England, British Society for Strain Measurement, 1981 26 p, Discussion, 2 p refs

The design and testing of the Space Shuttle remote manipulator system is discussed The measurement system specifications are stated and the selection of signal conditioning and strain gauge system are described The measurement system quality assurance and acceptance test plan is detailed, including the strain gauge installation procedure, the thermal effect on null balance, on combined gauge factor and material modulus test, and on gauge factor, the effect on indicated strain of vacuum and moisture, the strain gauge fatigue test, the temperature measurement system calibration, and the thermal effects on the integrated system The procedures for the strain gauge and temperature gauge shunt calibration are described, and the data processing and error budget analysis is summarized C D

A83-24747
SINGULAR VALUE ANALYSIS OF DEFORMABLE SYSTEMS
E A JONCKHEERE and L M SILVERMAN (Southern California, University, Los Angeles, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 660-668 refs
(Contract F44620-71-C-0067, AF-AFOSR-80-0013)

Singular value analysis, balancing, and approximation of a class of deformable systems are investigated The deformable systems considered herein include several important cases of flexible aerospace vehicles and are characterized by countably infinitely many poles and zeros on the imaginary axis The analysis relies completely on the so-called asymptotic singular value decomposition of the Hankel operator associated with the impulse response of the system A parametric study of a six-dimensional single-input single-output case is performed (Author)

A83-24785
REDUCED ORDER MODELING OF LARGE SPACE STRUCTURES VIA LEAST SQUARES ESTIMATION
E FOGEL (Charles Stark Draper Laboratory, Inc, Cambridge, MA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York Institute of Electrical and Electronics Engineers, 1981, p 943-948 Research supported by the Charles Stark Draper Laboratory, Inc refs

The effect of reducing the order of a system by means of identification is studied The relation between n-th order and n+1-st least squares estimated models, and the relation between least squares estimation and stability theory are employed to establish the limitation (in terms of stability) of a controller designed for a reduced order model, when applied to the full order model (Author)

A83-25755
LOW COST COLD PLATE APPROACH FOR LARGE SPACE PLATFORMS
L R PRICE, N J LEINDECKER, and L P MORATA (McDonnell Douglas Astronautics Co, St Louis, MO) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 12th, San Diego, CA, July 19-21, 1982, SAE 11 p
(SAE PAPER 820843)

Present spacecraft cold-plate designs are small in size, relatively complex, and expensive A new large-size, low-cost approach is required for the new generation of space power modules and platforms This paper describes an on-going investigation of the feasibility of utilizing large cross-section aluminum extrusions attached side by side to form a large, two-sided cold plate with integral coolant passages This simply formed assembly provides the thermal and structural characteristics to meet spacecraft requirements This same approach is also applicable to two-sided spacecraft radiators (Author)

A83-25761
THERMAL CONCEPTS DERIVED FROM SPACELAB FOR ADVANCED SPACE STATIONS/PLATFORMS
E VALLERANI, S LIOY, and B SESSIONS (Aeritalia S p A, Settore Spazio, Turin, Italy) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 12th, San Diego, CA, July 19-21, 1982, SAE 15 p Research sponsored by the European Space Agency refs
(SAE PAPER 820861)

Thermal control concepts derived from Spacelab for advanced space stations/platforms are reviewed Concepts discussed are based on trade studies performed to determine the applicability of Spacelab hardware (baseline and modified) to such systems as the American-NASA Space Operations Center (SOC), Science and Application Manned Space Platform (SAMSP) and unmanned platform (SASP) and the European-ESA unmanned Free Flyer Platforms Design changes to Spacelab hardware and new development items needed to meet the design requirements of space facility concepts are identified Finally, design preferences and performance predictions for the thermal control concepts of interest are given Portions of this work have been prepared by Aeritalia for the Follow-On-Development (FOD) Medium Term Study sponsored by the European Space Agency (ESA) (Author)

A83-25764
CONTROL PHILOSOPHY CONCEPTS IN COMPLEX SPACE HEAT REJECTION SYSTEMS
V MARCHIS (Torino, Politecnico, Turin, Italy) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 12th, San Diego, CA, July 19-21, 1982, SAE 15 p refs
(SAE PAPER 820864)

Various types of radiator thermal control systems are considered with reference to spaceborne payloads and to those systems developed for Skylab and the Space Shuttle Attention is given to such thermal control techniques as flow variation, radiator bypass, the partition of coolant flow among parallel panels, regenerative heat exchange bypasses, and supplementary cooling assemblies The article also evaluates a decentralized dedicated control unit, a central control unit, and a discoupled control design by use of the inverse Nyquist array method S C S

A83-27127* Los Alamos Scientific Lab, N Mex
LONG TITANIUM HEAT PIPES FOR HIGH-TEMPERATURE SPACE RADIATORS
S P GIRRENS (Los Alamos National Laboratory, Los Alamos, NM) and D M ERNST (Thermacore, Inc, Lancaster, PA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 47-51
(Contract JPL-955935, NAS7-100)

Titanium heat pipes are being developed to provide light weight, reliable heat rejection devices as an alternate radiator design for the Space Reactor Power System (SP-100) The radiator design includes 360 heat pipes, each of which is 5 2 m long and dissipates 3 kW of power at 775 K The radiator heat pipes use potassium as the working fluid, have two screen arteries for fluid return, a roughened surface distributive wicking system, and a D-shaped cross-section container configuration A prototype titanium heat pipe, 5 5-m long, has been fabricated and tested in space-simulating conditions Results from startup and isothermal operation tests are presented These results are also compared to theoretical performance predictions that were used to design the heat pipe initially (Author)

A83-27128
ARTERY HEAT PIPES FOR SPACE POWER SYSTEMS
M MERRIGAN, C PRENGER, E MARTINEZ, and J RUNYAN (Los Alamos National Laboratory, Los Alamos, NM) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, p 52-57 refs

Design requirements and progress on sodium-filled heat pipes for carrying heat from a space-based reactor core to thermoelectric elements are discussed An operating temperature of 1500 K, coupled to a high evaporator radial power density, has indicated boiling at the evaporator wall Each heat pipe is required to have a thermal capacity of 15 kWt, an axial power density of 10 kWt, a length of 2 m, and a 90 deg bend around a 180 mm radius reactor Material choices have been limited to Mo alloys by ductility criteria, although the finest Mo mesh screen material for distribution wicks has a pore size that is a factor of four too large An artery heat pipe configuration has been selected for redundancy features Optimization of the wick configuration and permeability are still necessary in the artery configuration Use of a MoRe alloy for the mesh and liquid lithium for the heat transfer fluid as alternatives for the SP-100 space power system are being considered for the next generation design D H K

A83-27129
DEVELOPMENT OF HIGH-TEMPERATURE LIQUID METAL HEAT PIPES FOR ISOTHERMAL IRRADIATION ASSEMBLIES
E S KEDDY and H E MARTINEZ (Los Alamos National Laboratory, Los Alamos, NM) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, p 58-62 refs

Design features, materials considerations, and preliminary test results of the fuel configuration for a 10-100 kWe space-power reactor are reported The Mo heat pipes, one using liquid Na and another liquid Li, were examined with Mo mesh placed in the interior for fluid distribution and to prevent a gravity return of the condensate RF heating was used and measurements were made with calorimetry and optical pyrometry The mesh performed satisfactorily for both heat transfer fluids The innovative pin geometry, which features layers of UO2 sandwiched between Mo wafers to provide the major conduction paths to the core heat pipes, will require testing in the EBR-III reactor The 3 6 MW/sq cm input experienced in the preliminary tests was twice that expected in the EBR III trials, when fuel swelling will also be examined D H K

A83-29740*# Naval Postgraduate School, Monterey, Calif
ADS-1 - A NEW GENERAL-PURPOSE OPTIMIZATION PROGRAM
G N VANDERPLAATS (U S Naval Postgraduate School, Monterey, CA), C M SPRAGUE (U S Naval Postgraduate School, Monterey, CA, U S Coast Guard, Washington, DC), and H SUGIMOTO IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 117-123 NASA-supported research refs
(AIAA 83-0831)

Today, numerous programs are available which may be coupled with finite element analysis or other analysis techniques to perform the optimization function in the solution of structural synthesis problems However, most of these codes include only one or two algorithms and many have not been tested on problems of significant size and complexity There is, therefore, a need for a reliable, general-purpose, publicly available code, containing a variety of modern algorithms for use in structural synthesis as well as general engineering design The ADS-1 program (Automated Design Synthesis Version 1) was written in response to this need The present investigation has the objective to present the capabilities of the ADS program and to demonstrate its application to structural synthesis The ADS program solves the general nonlinear constrained optimization problem in the standard form At each level of the optimization process, several options are available G R

A83-29767#
MINIMUM WEIGHT DESIGN OF STRUCTURES WITH GEOMETRIC NONLINEAR BEHAVIOR
N S KHOT (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) and M P KAMAT (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 383-391 refs
(AIAA 83-0937)

The paper presents an optimization method based on optimality criterion for minimum weight design of structures with geometric nonlinear behavior The nonlinear critical load is determined by finding the load level at which the Hessian of the potential energy ceases to be positive definite A recurrence relation based on the criterion that at optimum the nonlinear strain energy density be equal to all the members is used to develop an algorithm Sample problems are given to illustrate the application of the method to truss type structures with a large number of design variables Author

A83-29793*# Cincinnati Univ, Ohio
EFFECTIVE CONSTITUTIVE RELATIONS FOR THE MICROSTRUCTURE OF PERIODIC FRAMES
A H NAYFEH, M S HEFZY (Cincinnati, University, Cincinnati, OH), and M S HARTLE IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 623-629 refs
(Contract NSG-1185)
(AIAA 83-1006)

Effective micro-structure properties of two-dimensional large repetitive frame-like structures are derived using straightforward combinations of energy methods of linear transformations Once the actual structure is identified symmetry considerations are used in order to identify its independent property constants The actual values of these constants are constructed according to a building block format which is carried out in the three consecutive steps (1) all basic planar lattices are identified, (2) effective continuum properties are derived for each of these planar basic grids using energy methods, and (3) orthogonal transformations are finally used to determine the contribution of each basic set to the overall effective continuum properties of the structure Author

A83-29794#
AN EQUIVALENT CONTINUUM REPRESENTATION OF STRUCTURES COMPOSED OF REPEATED ELEMENTS
J O DOW, C C FENG (Colorado, University, Boulder, CO), and C S BODLEY (Martin Marietta Aerospace, Denver, CO) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 630-640 refs
(Contract F33615-82-K-3220)
(AIAA 83-1007)

A procedure which requires a minimum of intervention by the analyst for determining the equivalent continuum properties of a structure composed of repeated patterns of discrete elements with both displacement and rotational coordinates is presented The displacement and rotation coordinates are transformed to rigid body and strain gradient variables using a polynomial representation The maximum number of independent variables that may be retained is determined by applying a ranking procedure to either the resulting transformation matrix or the strain energy resulting transformation matrix or the strain energy expression Further constraints may be imposed by the analyst The equivalent continuum parameters result when a further transformation to the appropriate kinematic variables is applied and the strain energy expression is reduced to these variables Three-dimensional beam-like and plate-like structures are treated The results correspond to findings using other approaches Author

A83-29800*# Old Dominion Univ , Norfolk, Va
THERMAL-STRUCTURAL ANALYSIS OF LARGE SPACE STRUCTURES - AN ASSESSMENT OF RECENT ADVANCES
E A THORNTON (Old Dominion University, Norfolk, VA) and D B PAUL (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 683-696 USAF-NASA-supported research refs
(AIAA 83-1018)

Recent advances in modeling, analyzing, and understanding the thermal-structural responses of large space structures are reviewed, and uncertainties in the thermal-structural analysis are identified Typical heat-load, thermal, and structural analyses requirements for large space structures are discussed using a design for a future large spacecraft as an example The current status of heating, thermal, and structural analyses is then reviewed, and computer programs used in research and design are discussed The need to develop efficient methods for integrating the interdisciplinary analyses is emphasized V L

A83-29801*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
EFFECTS OF RANDOM MEMBER LENGTH ERRORS ON THE ACCURACY AND INTERNAL LOADS OF TRUSS ANTENNAS
W H GREENE (NASA, Langley Research Center, Structures and Dynamics Div , Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 697-704 refs
(AIAA 83-1019)

The effects of random member length errors on the surface accuracy, the defocus, and the residual, internal loads of tetrahedral truss antenna reflectors have been studied analytically The analytical procedure involves performing multiple, deterministic finite element structural analyses for a particular truss For each analysis, the normally distributed, random member length errors are selected by random number generator A best fit paraboloid analysis is used to determine a root mean square error and defocus from each analysis The statistical properties of these quantities as well as the internal loads are calculated from the results of many independent analyses Results indicate that the number of members in a tetrahedral truss antenna of a given diameter has a significant effect on surface accuracy, defocus and internal loads It was also found that the member axial stiffnesses and antenna focal length have a very small effect on reflector surface accuracy Author

A83-29802*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
APPLICATION OF DATA MANAGEMENT TO THERMAL/STRUCTURAL ANALYSIS OF SPACE TRUSSES
V A ROGERS (NASA, Langley Research Center, Hampton, VA, Drexel University, Philadelphia, PA), T R SUTTER, C L BLACKBURN (Kentron Technical Center, Hampton, VA), and S H CHOI (Information and Control Systems, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 705-713 refs
(AIAA 83-1020)

A relational data base management system has been used for managing engineering data in a prototype computerized thermal/structural integrated design system The resulting system has been applied to the analysis of a tetrahedral space truss to demonstrate and evaluate the ability to store, retrieve, query, modify, and manipulate data Key software used includes relational data management software, several applications programs, and selected integrated software developed during the study Results discussed include system development, system use and performance, and advantages of an integrated data management system Author

A83-32761#
DEVELOPMENT AND TEST OF A SPACE REACTOR CORE HEAT PIPE
M A MERRIGAN, J E RUNYAN, H E MARTINEZ, and E S KEDDY (Los Alamos National Laboratory, Los Alamos, NM) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983 10 p refs
(AIAA PAPER 83-1530)

A heat pipe designed to meet the heat transfer requirements of a 100 kW electrical power space nuclear power system has been developed and tested General design requirements for the device included an operating temperature of 1500 K with an evaporator radial flux density of 100 w/sq cm The total heat pipe length of 2 m comprised an evaporator length of 0 3 m, a 1 2 m adiabatic section, and a condenser length of 0 5 m A four artery design was used with lithium serving as the working fluid Molybdenum alloys were used for the screen materials and tube shell Hafnium and zirconium gettering materials were used in connection with a prepurified distilled lithium charge to ensure internal chemical compatability The pipe was operated successfully at an axial power level greater than 10 kW/sq cm for 100 hrs at 1500 K The tests demonstrated both the adequacy of the design and the short-term compatibility of the materials C D

N83-13151*# Vought Corp , Dallas, Tex
SYSTEMS EVALUATION OF THERMAL BUS CONCEPTS Final Report
D D STALMACH 9 Feb 1982 123 p refs
(Contract NAS9-16321)
(NASA-CR-167774, NAS 1 26 167774, REPT-2-53200/2R-53050)
Avail NTIS HC A06/MF A01 CSCL 22B

Thermal bus concepts, to provide a centralized thermal utility for large, multihundred kilowatt space platforms, were studied and the results are summarized Concepts were generated, defined, and screened for inclusion in system level thermal bus trades Parametric trade studies were conducted in order to define the operational envelope, performance, and physical characteristics of each Two concepts were selected as offering the most promise for thermal bus development All of four concepts involved two phase flow in order to meet the required isothermal nature of the thermal bus Two of the concepts employ a mechanical means to circulate the working fluid, a liquid pump in one case and a vapor compressor in another Another concept utilizes direct osmosis as the driving force of the thermal bus The fourth concept was a high capacity monogroove heat pipe After preliminary sizing and screening, three of these concepts were selected to carry into the trade studies The monogroove heat pipe concept was deemed unsuitable for further consideration because of its heat transport limitations One additional concept utilizing capillary forces to drive the working fluid was added Parametric system level trade studies were performed Sizing and weight calculations were performed for thermal bus sizes ranging from 5 to 350 kW and operating temperatures in the range of 4 to 120 C System level considerations such as heat rejection and electrical power penalties and interface temperature losses were included in the weight calculations Author

N83-13155# Aerospace Corp, El Segundo, Calif Vehicle Engineering Div
DEVELOPMENT OF AN ANALYTICAL MODEL FOR LARGE SPACE STRUCTURES Final Report, Oct. 1980 - Sep. 1981
M ASWANI 15 Mar 1982 99 p refs
(Contract F04701-81-C-0082)
(AD-A119349, TR-0082(9975)-1, SD-TR-82-59) Avail NTIS HC A05/MF A01 CSCL 12A

A methodology is presented for modeling large truss-type structures based on the concept of equivalent continuum The equivalent effective elastic and dynamic properties of the continuum model in terms of the material and geometric properties of the truss are derived in a simple and straightforward manner The accuracy of the model is demonstrated in a free vibration problem, when the results are compared to those obtained from the conventional finite element method Both simply supported and free-free boundary conditions are considered In addition, the assumptions made in obtaining the continuum solution are discussed Numerical results clearly indicate the potential of this approach for modeling large repetitive truss-type structures Author (GRA)

N83-13478 Columbia Univ, New York
CONTINUUM MODELING OF LARGE DISCRETE STRUCTURAL SYSTEMS Ph.D. Thesis
H S FLUSS 1982 118 p
Avail Univ Microfilms Order No DA8222383

A least square formulation is presented for the modeling of a discrete structural system by an equivalent continuum The discrete continuum analogy is developed by isolating a unit cell of the structure and then replacing it with a continuum element The continuum constitutive properties are determined such that they minimize the difference in strain energy between the two systems This minimization procedure is given both for continuum elements assumed to be in a state of constant strain, as well as for flexural elements in constant curvature The proposed approach is first applied to the classical elastic continuum modeling of trusses and frames In the case of trusses, the derived constitutive parameters are verified For frames, the ability of a classically elastic continuum to model the framed cell behavior is analyzed, and it is shown that classical is overly restrictive Dissert Abstr

N83-14429*# Old Dominion Univ, Norfolk, Va
IMPROVED FINITE ELEMENT METHODOLOGY FOR INTEGRATED THERMAL STRUCTURAL ANALYSIS Progress Report, period ending 30 Jun. 1982
P DECHAUMPHAI and E A THORNTON Washington NASA Nov 1982 194 p refs
(Contract NSG-1321)
(NASA-CR-3635, NAS 1 26 3635) Avail NTIS HC A09/MF A01 CSCL 20D

An integrated thermal-structural finite element approach for efficient coupling of thermal and structural analyses is presented New thermal finite elements which yield exact nodal and element temperature for one dimensional linear steady state heat transfer problems are developed A nodeless variable formulation is used to establish improved thermal finite elements for one dimensional nonlinear transient and two dimensional linear transient heat transfer problems The thermal finite elements provide detailed temperature distributions without using additional element nodes and permit a common discretization with lower order congruent structural finite elements The accuracy of the integrated approach is evaluated by comparisons with analytical solutions and conventional finite element thermal-structural analyses for a number of academic and more realistic problems Results indicate that the approach provides a significant improvement in the accuracy and efficiency of thermal stress analysis for structures with complex temperature distributions Author

N83-14519 Illinois Univ, Chicago
MATERIAL NONLINEAR ANALYSIS OF 3-D AND AXISYMMETRIC STRUCTURES (UNDER ARBITRARY LOADS) USING HYBRID STRESS FINITE ELEMENTS Ph.D. Thesis
S P SINGH 1982 182 p
Avail Univ Microfilms Order No DA8220025

The hybrid stress finite element model is used to develop a 20-node, isoparametric, quadratic displacement three dimensional element designated as SH69Q Linear elastic, elasto-plastic, viscoplastics and creep analyses of three dimensional and axisymmetric structures subject to arbitrary loads are considered A hybrid stress based initial-stress formulation is presented for elastoplastic analysis of 3-D structures The semi-analytic technique of linear analysis is extended to elastoplastic, visco-plastic and creep analysis of axisymmetric structures subject to arbitrary loads Agreement is observed between two solutions along with savings in computational effort and time through semianalytic approach in elastoplastic and viscoplastic problems In creep analysis semianalytic solution is found to be of inferior accuracy to the 3-D (SH69Q) solution Dissert Abstr

N83-14724# European Space Agency, Noordwikj (Netherlands)
SPACE TELESCOPE: SOLAR PANEL ASSEMBLY THERMAL TEST ANALYSIS
E K JAEKEL, G I M BEERE, and B G M AALDERS *In its* Photovoltaic Generators in Space p 193-200 Jun 1982 refs
Avail NTIS HC A15/MF A01

The Space Telescope solar panel assembly (ST-SPA) was tested in a thermal vacuum, for formal qualification and design verification of the SPA including the shunt diodes The ST-SPA was instrumented with 60 thermocouples and 2 thermistors In parallel to the thermal sensor readings, thermograms with an infrared camera were taken Thermograms are reproduced, and updates of the thermal mathematical models are given The use of a calibrated solar flux allowed an update of the thermo-optical properties for the SPA Optical properties are alpha S = 0 53, Sigma H = 0 76 for the rear side, and alpha S = 0 86, Sigma H = 0 78 (unloaded) for the front Solar cell and shunt diode temperature for flight environments are included Author (ESA)

N83-15889# Grumman Aerospace Corp, Bethpage, N Y
THERMAL MANAGEMENT OF LARGE PULSED POWER SYSTEMS Final Report
B HASLETT *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 36 p 1982 refs
Avail NTIS HC A99/MF A01

Current thermal control technology is reviewed and limitations assessed compared to a typical high pulse power application Thermal management is a significant weight factor (approximately 50%) of even medium power systems which points to a large potential payback from innovative techniques Thermal research is recommended in the areas of concentrating and thermovoltaic solar arrays, two phase heat transport loops, direct contact heat exchangers and advanced radiator systems Air Force space power trends indicate requirements for systems with 10 to 200 KW average power with pulse/average power ratios of 10/1 to 1000/1 Thermal system definition is complicated by the variety of possible power systems although solar and nuclear (Brayton and Thermionic) appear to be the leading candidates R J F

N83-15897# Old Dominion Univ, Norfolk, Va Dept of Mechanical Engineering and Mechanics
UNCERTAINTIES IN THERMAL-STRUCTURAL ANALYSIS OF LARGE SPACE STRUCTURES Final Report
E A THORNTON *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 17 p 1982 refs
Avail NTIS HC A99/MF A01
Uncertainties in the thermal structural analysis of large space structures are briefly described Thermal structural design challenges faced by structural engineers are highlighted Some basic questions arising in predictive analyses are identified and illustrated with recent research Areas for further research are discussed, and the need for fundamental thermal structural experiments is cited Author

N83-17583*# Old Dominion Univ, Norfolk, Va Dept of Mechanical Engineering and Mechanics
FUNDAMENTAL STUDIES OF HEAT LOAD AND THERMAL-STRUCTURE ANALYSIS OF LARGE SPACE STRUCTURES Progress Report, 16 May 1982 - 31 Jan 1983
E A THORNTON Feb 1983 4 p
(Contract NAG1-257)
(NASA-CR-169885, NAS 1 26 169885) Avail NTIS HC A02/MF A01 CSCL 22B
Investigation of the basic requirements for modeling slender member shadowing effects on thermally induced deformation continues The theoretical formulation is complete and computer programming is underway The basic requirements for thermal finite elements to model heat transfer in orbiting structures were also studied The need for planar isothermal elements to model large space structures' antenna meshes was established Finite Element approaches for modeling space structure cable and membrane components with thermal effects is underway Three levels of structural modeling and analysis were identified (1) a linear-elastic small deflection analysis that does not permit cable slackening, (2) a linear-elastic analysis that includes stress stiffening (the ANSYS program), but not large deflections, and (3) full nonlinear large deflection analysis with stress stiffening Methods of determining cable initial tensions are currently being evaluated A R H

N83-17900*# Old Dominion Univ, Norfolk, Va Dept of Mechanical Engineering and Mechanics
PROGRESS IN THERMOSTRUCTURAL ANALYSIS OF SPACE STRUCTURES
E A THORNTON, P DECHAUMPHAI, J MAHANEY, and A K PANDEY 1982 17 p refs Presented at the NASA Conf on Large Space Antenna Systems Technol, Hampton, Va, 30 Nov - 3 Dec 1982 Sponsored by NASA Langley Research Center, and AFFDL
(NASA-CR-169886, NAS 1 26 169886) Avail NTIS HC A02/MF A01 CSCL 20K
A finite element space structures research focused on the interdisciplinary problems of heating, thermal, and structural analysis is discussed Slender member shadowing effects, and cable stiffened structures are described S L

N83-18808# European Space Research and Technology Center, Noordwijk (Netherlands) Product Assurance Div
THE USE OF THERMO-ANALYTICAL TECHNIQUES IN MATERIALS EVALUATION
M D JUDD *In* ESA Spacecraft Mater in a Space Environ p 279-288 Jul 1982 refs
Avail NTIS HC A15/MF A01
The term 'thermal analysis' covers a group of related techniques whereby a particularly property of a material is measured as a function of temperature By the correcture of the appropriate technique it is possible to obtain information vital to the Materials Engineer in failure investigations This paper describes the four most important techniques and gives examples of their applications, these examples are taken from the normal day Project Support given by the Polymer Group of the ESTEC Materials Section Author

N83-18820*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ASSESSMENT OF CURRENT STATE OF THE ART IN MODELING TECHNIQUES AND ANALYSIS METHODS FOR LARGE SPACE STRUCTURES
A K NOOR (George Washington Univ) *In its* Modeling Analysis, and Optimization Issues for Large Space Struct p 5-32 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B
Advances in continuum modeling, progress in reduction methods, and analysis and modeling needs for large space structures are covered with specific attention given to repetitive lattice trusses As far as continuum modeling is concerned, an effective and verified analysis capability exists for linear thermoelastic stress, birfurcation buckling, and free vibration problems of repetitive lattices However, application of continuum *modeling to nonlinear analysis needs more development* Reduction methods are very effective for bifurcation buckling and static (steady-state) nonlinear analysis However, more work is needed to realize their full potential for nonlinear dynamic and time-dependent problems As far as analysis and modeling needs are concerned, three areas are identified loads determination, modeling and nonclassical behavior characteristics, and computational algorithms The impact of new advances in computer hardware, software, integrated analysis, CAD/CAM stems, and materials technology is also discussed M G

N83-18821*# General Dynamics/Convair, San Diego, Calif
RECENT DEVELOPMENTS IN THERMAL ANALYSIS OF LARGE SPACE STRUCTURES
R F ONEILL *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 33-54 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B
A numerical procedure for analysis of shadowed space heating of sparse structures, SSQ, is discussed The SSQ program avoids inordinate computational complexity by confining attention to a single elemental location on a structural member of interest throughout an entire orbital period, proceeding then to similar treatment of individual alternate locations The procedure considers a spacecraft in circular orbit and assumes fixed-Earth orientation of the spacecraft Shadow orientation and interval duration, merged shadows, and computation of solar heat flux and thermal response are addressed The output options of the SSQ FORTRAN 5 program and its efficiency are discussed Application of the system to the analysis of a parabolic expandable truss antenna is considered M G

N83-18826*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
THERMAL ANALYSIS CONSIDERATIONS FOR LARGE SPACE STRUCTURES
H M ADELMAN and C P SHORE *In its* Modeling Analysis, and Optimization Issues for Large Space Struct p 123-147 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B
A number of issues and needs relative to thermal analysis of large space structures and space stations are discussed Some indications of trends in the Langley thermal-structural analysis research program consistent with the issues and needs are also presented The main heat transfer mechanism in space is radiation, consequently, there is a need for a strong thrust on improved radiation analysis capability Also the important interactions among temperatures, deformations, and controls need to be accounted for Finite element analysis capability seems to be lagging behind lumped-parameter capability or heat pipe analysis The Langley plan will include improving radiation analysis capability, evaluating the errors involved in certain approximate analysis and modeling techniques for large space trusses, and continuing the development of integrated thermal-structural finite elements with an emphasis

on radiation heat transfer Work will be initiated to develop finite element analysis techniques for heat pipes Finally, optimization research activities will be oriented toward methods to design flexible orbiting structures to account for thermal and thermal deformation requirements M G

N83-22541*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
DESIGN, FABRICATION AND TEST OF LIQUID METAL HEAT-PIPE SANDWICH PANELS
A BASIULIS (Hughes Aircraft Co , Torrance, Calif) and C J CAMARDA Apr 1983 9 p refs Presented at AIAA/ASME 3rd Joint Thermophys , Fluids, Plasma and Heat Transfer Conf , St Louis, 7-11 Jun 1982 Prevously announced in IAA as A82-31898
(NASA-TM-84631, NAS 1 15 84631) Avail NTIS HC A02/MF A01 CSCL 20D

Integral heat-pipe sandwich panels, which synergistically combine the thermal efficiency of heat pipes and the structural efficiency of honeycomb sandwich panel construction, were fabricated and tested The designs utilize two different wickable honeycomb cores, facesheets with screen mesh sintered to the internal surfaces, and potassium or sodium as the working fluid Panels were tested by radiant heating, and the results indicate successful heat pipe operation at temperatures of approximately 922K (1200F) These panels, in addition to solving potential thermal stress problems in an Airframe-Integrated Scramjet Engine, have potential applications as cold plates for electronic component cooling, as radiators for space platforms, and as low distortion, large area structures Author

N83-25147# Los Alamos Scientific Lab , N Mex
DEVELOPMENT OF HIGH-TEMPERATURE LIQUID-METAL HEAT PIPES FOR ISOTHERMAL IRRADIATION ASSEMBLIES
E S KEDDY and H E MARTINEZ 1982 6 p refs Presented at the 17th Intersoc Energy Conversion Eng Conf , Los Angeles, 8-13 Aug 1982
(Contract W-7405-ENG-36)
(DE82-016073, LA-UR-82-1273, CONF-820814-8) Avail NTIS HC A02/MF A01

This paper describes the development of high-temperature heat pipes and their operating performance using liquid metal working fluids to provide high heat transfer assemblies for in-pile testing of UO2 fuel The fuel assembly consists of thin UO2 wafers sandwiched between molybdenum discs, and is one of the components of the space nuclear reactor electrical power plant currently under development The intended operation of the heat pipes is to control the temperature of the UO2 irradiation experiment in the Experimental Breeder Reactor (EBR-II) This application involves vertical operation in a gravity-assist mode, with the evaporator end down Heat pipe construction and preparation techniques are described Laboratory tests were made and the performance characteristics determined Test results are compared with calculated heat transfer limit DOE

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STRUCTURAL DYNAMICS AND CONTROL

Includes modeling, systems identification, attitude and control techniques and systems, surface accuracy measurement and control techniques and systems, sensors, and actuators

A83-12456#
DEVELOPMENT OF DYNAMICS AND CONTROL SIMULATION OF LARGE FLEXIBLE SPACE SYSTEMS
J Y L HO and D R HERBER (Lockheed Missiles and Space Co , Inc , Sunnyvale, CA) In Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, 1982, p 367-378 refs

The development of the ALLFLEX dynamic and control simulation computer program for large flexible multibody space systems is presented, based on a systems analysis The analysis first examines the dynamic behavior of a typical interconnected body using a quasi-static approach, and dynamic formulation is linearized by the perturbation method All possible system topologies are considered using the direct path method for the development of complex kinematic relations In addition, a multibody system definition, orbital motion, nominal motion, and perturbed motion are among aspects considered for the computer simulation From the derived equations, the simulation is presented for which the execution of the second level subroutines is regulated by a central executive subroutine R K R

A83-12475*# TRW, Inc , Redondo Beach, Calif
OPTIMAL SUN-ALIGNMENT TECHNIQUES OF LARGE SOLAR ARRAYS IN ELECTRIC PROPULSION SPACECRAFT
H F MEISSINGER, C L DAILEY (TRW, Inc , Space and Technology Group, Redondo Beach, CA), and M E VALGORA (NASA, Lewis Research Center, Cleveland, OH) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 13 p refs
(Contract NAS3-22661)
(AIAA PAPER 82-1898)

Optimum sun-alignment of large solar arrays in electric propulsion spacecraft operating in earth orbit requires periodic roll motions around the thrust axis, synchronized with the apparent conical motion of the sun line This oscillation is sustained effectively with the aid of gravity gradient torques while only a small share of the total torque is being contributed by the attitude control system Tuning the system for resonance requires an appropriate choice of moment-of-inertia characteristics To minimize atmospheric drag at low orbital altitudes the solar array is oriented parallel, or nearly parallel, to the flight direction This can increase the thrust-to-drag ratio by as much as an order of magnitude Coupled with optimal roll orientation, this feathering technique will permit use of electric propulsion effectively at low altitudes in support of space shuttle or space station activities and in spiral ascent missions (Author)

A83-12754* Duke Univ , Durham, N C
NONLINEAR EQUATIONS OF DYNAMICS FOR SPINNING PARABOLOIDAL ANTENNAS
S UTKU, W L SHOEMAKER (Duke University, Durham, NC), and M SALAMA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) (Symposium on Advances and Trends in Structural and Solid Mechanics, Washington, DC, Oct 4-7, 1982) Computers and Structures, vol 16, no 1-4, 1983, p 361-370 refs
(Contract NAS7-100)

The nonlinear strain-displacement and velocity-displacement relations of spinning imperfect rotational paraboloidal thin shell antennas are derived for nonaxisymmetrical deformations Using these relations with the admissible trial functions in the principle functional of dynamics, the nonlinear equations of stress inducing motion are expressed in the form of a set of quasi-linear ordinary differential equations of the undetermined functions by means of the Rayleigh-Ritz procedure These equations include all nonlinear terms up to and including the third degree Explicit expressions are given for the coefficient matrices appearing in these equations Both translational and rotational off-sets of the axis of revolution (and also the apex point of the paraboloid) with respect to the spin axis are considered Although the material of the antenna is assumed linearly elastic, it can be anisotropic G R

A83-13204
OSCILLATIONS OF A SATELLITE WITH COMPENSATING DEVICES IN AN ELLIPTICAL ORBIT [KOLEBANIIA SPUTNIKA S KOMPENSIRUIUSHCHIMI USTROISTVAMI NA ELLIPTICHESKOI ORBITE]
I P POLIANSKAIA Kosmicheskie Issledovaniia, vol 20, Sept -Oct 1982, p 674-681 *In Russian refs*
A theoretical study of the motion of a satellite in an elliptical orbit under the effect of gravity forces is presented Two satellite designs are considered (1) a satellite with a one-degree-of-freedom flywheel, and (2) a satellite with extendible booms The rotation of the flywheel and changes in the length of the booms are chosen so as to compensate for eccentric oscillations Periodic motions of the satellite and their stability are investigated B J

A83-14174*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
DECOUPLING THE STRUCTURAL MODES ESTIMATED USING RECURSIVE LATTICE FILTERS
N SUNDARARAJAN and R C MONTGOMERY (NASA, Langley Research Center, Spacecraft Control Branch, Hampton, VA) Institute of Electrical and Electronics Engineers, Conference on Decision and Control, 21st, Orlando, FL, Dec 8-10, 1982, Paper 3 p
A method is presented for decoupling modal amplitudes generated by recursive least squares lattice filters The proposed method, which involves transformation of basis functions obtained from lattice filters, is illustrated using a free-free beam simulation The decoupled mode shape functions are required for the implementation of an adaptive control scheme for large space systems V L

A83-14844#
COMPUTATION OF A DEGREE OF CONTROLLABILITY VIA SYSTEM DISCRETIZATION
G KLEIN, R W LONGMAN (Columbia University, New York, NY), and R E LINDBERG, JR (U S Navy, Naval Research Laboratory, Washington, DC) (Virginia Polytechnic Institute and State University and American Institute of Aeronautics and Astronautics, Symposium on Dynamics and Control of Large Flexible Spacecraft, 3rd, Blacksburg, VA, June 15-17, 1981) Journal of Guidance, Control, and Dynamics, vol 5, Nov -Dec 1982, p 583-588 refs
A conservative approximation technique is developed for estimating the degree of controllability of general linear time-invariant systems The procedure involves the discretization of the continuous system and the computing of the degree of controllability of the resulting discrete system The computation of this value is reduced to the performing of a Gram-Schmidt orthonormalization on the columns of a linear mapping from the discrete control space to the state space This technique is found to avoid the divergence problem associated with the original approximation technique In addition, a simple example is used to develop a straightforward approach to selecting the appropriate step size for the discretization N B

A83-14845#
ATTITUDE CONTROL OF A SATELLITE WITH A ROTATING SOLAR ARRAY
J -P CHRETIEN, C REBOULET, P RODRIGO (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France), and M MAURETTE (Centre National d'Etudes Spatiales, Toulouse, France) (Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers, p 121-130) Journal of Guidance, Control, and Dynamics, vol 5, Nov -Dec 1982, p 589-596 Centre National d'Etudes Spatiales
(Contract CNES-80-0607)
(Previously cited in issue 21, p 3638, Accession no A81-44090)

A83-15378
THE STABILITY OF ROTATION OF A RIGID BODY WITH FLEXIBLE ELEMENTS [OB USTOICHIVOSTI VRASHCHENIIA TVERDOGO TELA S GIBKIMI ELEMENTAMI]
L V DOKUCHAEV and O P KLISHEV Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela, Sept -Oct 1982, p 10-15 In Russian refs
Equations of motion are obtained for the rotation of a spacecraft with two inclined elastic booms, and precise regions of the asymptotic stability of this rotation are established in the plane of constructive parameters The effect of the angle of the booms to the spacecraft on the variation of the region of stability is analyzed Necessary and sufficient conditions are obtained for the stability of a nontrivial equilibrium position for rods which are inclined at an arbitrary angle to the axis of rotation of the body N B

A83-15380
THE STABILITY OF MOTION OF A FLEXIBLE CABLE WITH LOADS IN A NEWTONIAN FORCE FIELD [OB USTOICHIVOSTI DVIZHENIIA GIBKOI NITI S GRUZAMI V N'IUTONOVSKOM POLE SIL]
G G EFIMENKO and N V KRIVONOSOVA Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela, Sept -Oct 1982, p 22-27 In Russian refs
The librational and rotational regimes of motion of a flexible cable with loads on the ends in a Newtonian force field is studied Equations of the disturbed motion of the cable are transformed into Hill equations, which are then investigated by asymptotic and numerical methods Regions of dynamic instability are constructed in the plane of the system parameters, which characterize the natural frequency of the oscillations and the level of energy relative to the motion of the cable N B

A83-16121#
DESIGN OF SPACE STRUCTURE CONTROL SYSTEMS USING ON-OFF THRUSTERS
W E VANDER VELDE (MIT, Cambridge, MA) and J HE (National Academy of Space Technology, Beijing, People's Republic of China) Journal of Guidance, Control, and Dynamics, vol 6, Jan -Feb 1983, p 53-60 refs
(AIAA PAPER 81-1847)
The problem of designing control systems for large, flexible space structures is addressed for the case in which control actuation is by means of on-off thrusters A direct synthesis procedure is suggested which is applicable to systems with dynamic models of any order using any number of thrusters The design is based on an approximation to an optimal control formulation which minimizes a weighted combination of response time and fuel consumption An example of the technique is given for the case of a flexible free-free beam using four thruster pairs (Author)

A83-16466*# Jet Propulsion Lab, California Inst of Tech, Pasadena

A SPLIT DELTA-V TECHNIQUE FOR DRIFT CONTROL OF GEOSYNCHRONOUS SPACECRAFT

F A KECHICHIAN (California Institute of Technology, Jet Propulsion Laboratory, Navigation Systems Section, Pasadena, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 18 p

(AIAA PAPER 83-0017)

A split-delta-V technique is presented for the east-west stationkeeping of geosynchronous spacecraft using the linearized optimal transfer strategies for near-circular coplanar orbits The maneuvers are carried out by taking advantage of the dynamics of the spacecraft in order to cancel out the effect of the drift accumulated between successive impulsive delta-V's A stability analysis is then carried out in order to determine the effect of implementing a series of precanned maneuvers at the end of each drift cycle in an autonomous mode by taking into account initial orbit determination uncertainties and execution errors emanating from each delta-V It is shown that small tolerance deadbands are violated after only a few cycles and the system is unstable (Author)

A83-16641#

THE OPTIMAL PROJECTION APPROACH TO FIXED-ORDER COMPENSATION - NUMERICAL METHODS AND ILLUSTRATIVE RESULTS

D C HYLAND (MIT, Lexington, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 11 p USAF-sponsored research refs

(AIAA PAPER 83-0303)

A convergent computational algorithm is developed for the solution of the optimality conditions for fixed-order dynamic compensation which arise from the optimal projection design approach for flexible mechanical systems, including large flexible spacecraft These optimality conditions determine the gains and also the optimal projection, an idempotent matrix, which defines the geometric structure of the compensator This technique is applied to the case of the fixed-order compensation of a simple structural system in order to illustrate the convergence of the algorithm and important properties of the control design, such as guaranteed closed-loop stability and optimality An additional advantage of the optimal projection approach, in contrast to the parameter optimization technique, is that no trial and error procedures are involved, as well as providing sufficient insight to secure global optimality N B

A83-16710*# Howard Univ, Washington, D C

EFFECT OF SOLAR RADIATION DISTURBANCE ON A FLEXIBLE BEAM IN ORBIT

R KRISHNA and P M BAINUM (Howard University, Washington, DC) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 10 p refs

(Contract NSG-1414)

(AIAA PAPER 83-0431)

The uncontrolled dynamics of an orbiting flexible beam in the presence of solar radiation pressure forces is considered The effect of solar radiation forces and moments on the rigid and flexible modes of a free-free flexible beam is evaluated It is found that moments result only from the flexible symmetric modal deformations For small pitch amplitudes, and at near geosynchronous altitudes the solar radiation moments due to the deformations of the beam are seen to be greater than those due to the gravity-gradient Within the linear range, simulated steady state dynamic responses show that the induced pitch amplitudes can be more significant than the induced amplitudes of the modal shape functions (Author)

A83-16711#

TRANSIENT DYNAMICS DURING THE SPACE SHUTTLE BASED MANUFACTURE OF STRUCTURAL COMPONENTS - GENERAL FORMULATION OF THE PROBLEM

V J MODI (British Columbia, University, Vancouver, Canada) and A M IBRAHIM American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 11 p Natural Sciences and Engineering Research Council of Canada refs

(Contract NSERC-67-0662)

(AIAA PAPER 83-0432)

The paper presents a general formulation for studying librational dynamics of a large class of spacecraft during deployment of flexible members It is applicable to a variety of missions ranging from deployment of antennas, booms and solar panels from a spacecraft to manufacturing of trusses for space platforms using the Space Shuttle The governing nonlinear, nonautonomous, and coupled equations of motion are extremely difficult to solve even with the help of a computer, not to mention the cost involved The equations are so programmed on an AMDAHL 470-V8-II digital computer to help assess the effect of shifting center of mass, nonlinearity, change in inertia of the central rigid body during deployment, number of admissible functions, etc, which considerably complicate the problem The formulation is ideally suited to help assess the effect of complex interactions between flexibility, deployment, attitude dynamics, and stability for a large family of present as well as the next generation of spacecraft (Author)

A83-18389#

UNBALANCE BEHAVIOR OF SQUEEZE FILM DAMPED MULTI-MASS FLEXIBLE ROTOR BEARING SYSTEMS

L J MCLEAN and E J HAHN (New South Wales, University, Kensington, Australia) ASME, Transactions, Journal of Lubrication Technology, vol 105, Jan 1983, p 22-28 refs

A solution technique is developed whereby the problem of determining the synchronous unbalance response of general multi-degree of freedom rotor bearing systems is reduced to solving a set of as many simultaneous nonlinear equations in damper orbit eccentricities as there are dampers It is shown how, in the case of a single damper, the resulting nonlinear equation may be solved directly to determine all possible orbit eccentricity solutions as a function of the rotor speed and bearing parameter, thereby ensuring completeness of solution, eliminating convergence problems and clearly indicating all multistable operation possibilities Design maps portraying the effect of the relevant damper design parameters on system response may be conveniently obtained, allowing for optimal damper design The technique is illustrated for the case of a simple squeeze film damped symmetric flexible rotor (Author)

A83-21426

TETHER DEPLOYMENT DYNAMICS

A K BANERJEE and T R KANE (Stanford University, Stanford, CA) Journal of the Astronautical Sciences, vol 30, Oct-Dec 1982, p 347-365 refs

It is shown that grossly incorrect values for tether tensions can be obtained when only the instantaneously deployed portion of a tether undergoing a deployment (or retrieval) process is treated as extensible To generate a simulation that yields both correct tension information and a valid description of tether and end mass motions, the entire tether can be regarded as extensible and reel dynamics can be taken into account With this approach, it is found that the natural frequency of longitudinal vibrations of the tether does not depend on the length of the deployed portion but on the total length of the tether It is believed that the assumptions that the surface of the drum may be regarded as perfectly smooth and that the tether is wrapped on the drum at a constant radius must lead to disparities between the predictions of the theory at hand and the events that would occur in an experiment What is more, the system under consideration is too simple to serve as a model of an actual shuttle-borne tethered satellite, for it does not make it possible to make proper provision for orbital motions, flexural motions of the tether, and so forth C R

A83-22039#
ORBITAL ERROR ANALYSIS OF TIME SYNCHRONIZATION VIA GEOSTATIONARY BROADCAST SATELLITE
S KAWASE and T SATO Radio Research Laboratories, Journal, vol 29, July 1982, p 103-113 refs

Two useful methods are described for orbital error analysis of one-way geostationary satellite time synchronization One is a method of estimating the quality of orbital information of the satellite, and the other is a method of orbital interpolation which can improve the accuracy of calculated satellite position On the basis of these methods, a precision of 20 nanosec was obtained from an actual case of clock time comparison between the International Latitude Observatory of Mizusawa and the Radio Research Laboratories via a television broadcasting satellite (Author)

A83-23593* Sperry Flight Systems, Phoenix, Ariz
STABILITY OF MAGNETICALLY SUSPENDED OPTICS IN A VIBRATION ENVIRONMENT
B J HAMILTON (Sperry Corp , Sperry Flight Systems Div , Phoenix, AZ) In Control and communication technology in laser systems, Proceedings of the Twenty-fifth Annual International Technical Symposium, San Diego, CA, August 25, 26, 1981 Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p 154-161 refs
(Contract NAS1-15008)

The improving resolution capabilities of large spaceborne optical experiments are placing ever-increasing demands on platform stability in a vibration environment The present paper discusses the principles of magnetic suspension systems as a promising alternative to conventional methods The disadvantages of various conventional pointing mount geometrics are discussed, including the CG-mount approach and end-mount pointing, and advantages of a system whereby the payload has a high degree of isolation from the carrier in translation are pointed out The Annular Suspension and Pointing System Vernier System is then presented as a hardware realization of a complete magnetic suspension system consisting of six magnetic bearing assemblies controlling six degrees of freedom of payload motion in a standardized end-mount configuration A model of a simplified two-degrees-of-freedom isolation and pointing unit is considered and the transfer function from carrier translation to payload pointing is derived The function is evaluated for several degenerate cases corresponding to conventional mounting techniques and magnetic suspension Analytical performance predictions show a stability of better than 0 01 arcsec for a wide range of payloads in the worst-case shuttle disturbance environment S C S

A83-23595
TEN-CHANNEL VIBRATION SENSOR
C -C HUANG and T CHANG (Lockheed Missiles and Space Co , Inc , Sunnyvale, CA) In Control and communication technology in laser systems, Proceedings of the Twenty-fifth Annual International Technical Symposium, San Diego, CA, August 25, 26, 1981 Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p 170-175

A prototype 10-channel vibration sensor has been developed for use in the active control of the subhertz and submicron vibrations of future large, flexible space structures The sensor is based on a 0 7 mW HeNe laser, and two Bragg cells which are used to provide the target sensing beam with an offset frequency relative to the optical local oscillator and to split electronically the target beam into ten beams The optical phase shift on each beam reflected from its target corner cube can be detected with a single detector, since each beam is coded with a different offset frequency A 40-dB signal-to-noise ratio has been achieved, which indicated the feasibility of a 26-dB signal-to-noise ratio, sufficient for signal processing, in a 50-channel system Tests have also demonstrated a 0 08-micron amplitude resolution, which can be lowered to 0 02 microns by modified digital signal processing techniques A L W

A83-24355*# Jet Propulsion Lab , California Inst of Tech , Pasadena
CONTROL - DEMANDS MUSHROOM AS STATION GROWS
S Z SZIRMAY (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and J BLAIR (NASA, Marshall Space Flight Center, Huntsville, AL) Astronautics and Aeronautics, vol 21, Mar 1983, p 46-49

The NASA space station, which is presently in the planning stage, is to be composed of both rigid and nonrigid modules, rotating elements, and flexible appendages subjected to environmental disturbances from the earth's atmospheric gravity gradient, and magnetic field, as well as solar radiation and self-generated disturbances Control functions, which will originally include attitude control, docking and berthing control, and system monitoring and management, will with evolving mission objectives come to encompass such control functions as articulation control, autonomous navigation, space traffic control, and large space structure control Attention is given to the advancements in modular, distributed, and adaptive control methods, as well as system identification and hardware fault tolerance techniques, which will be required O C

A83-24431#
DYNAMICS OF A SPACECRAFT DURING EXTENSION OF FLEXIBLE APPENDAGES
K TSUCHIYA (Mitsubishi Electric Corp , Central Research Laboratory, Hyogo, Japan) Journal of Guidance, Control and Dynamics, vol 6, Mar -Apr 1983, p 100-103 refs

This paper deals with the attitude behavior of a spacecraft with a rotor during extension of flexible appendages The analysis is based on the method of multiple scales The equations of motion are formulated using a spacecraft modal coordinate scheme The analytical expressions for the attitude behavior of the spacecraft are obtained The extension of the appendages plays a significant role in the stability of the attitude motion of the spacecraft In some cases, the attitude motion of the spacecraft will become unstable (Author)

A83-24432#
ROBUST CONTROL OF FLEXIBLE SPACECRAFT
R L KOSUT (Integrated Systems, Inc , Palo Alto, CA), H SALZWEDEL, and A EMAMI-NAEINI (Systems Control Technology, Inc , Palo Alto, CA) Journal of Guidance, Control and Dynamics, vol 6, Mar -Apr 1983, p 104-111 refs

It is noted that a well-designed feedback control system exhibits the properties of external disturbance attenuation and performance robustness with respect to plant uncertainty Among the plant uncertainties of flexible spacecraft are unmodeled dynamics and parameter uncertainties Singular value robustness measures are used in comparing the performance and stability robustness properties of different control design techniques in the presence of residual modal interaction (control and observation spillover) for a design example that is representative of a practical flexible spacecraft system Among the control designs evaluated here are linear quadratic geometry (LQG) control, integral feedback, bias removal control, innovations feedthrough, and frequency-shaped LQG C R

A83-24722* Jet Propulsion Lab , California Inst of Tech , Pasadena
STATIC SHAPE DETERMINATION AND CONTROL FOR A LARGE SPACE ANTENNA
C WEEKS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 1 New York, Institute of Electrical and Electronics Engineers, 1981, p 495-501 refs

An integral operator approach is used to derive solutions to static shape determination and control problems associated with large space structures Problem assumptions include a linear self-adjoint system model, observations and control forces at discrete points, and quadratic performance criteria for the comparison of estimates or control forces Results are illustrated by simulations with a finite element model of a large space antenna Modal expansions for terms in the solution algorithms are presented, using modes from the static or associated dynamic model These expansions provide approximate solutions in the event that a closed form analytical solution to the system boundary value problem is not available (Author)

A83-24754

DIGITAL STOCHASTIC CONTROL OF DISTRIBUTED-PARAMETER SYSTEMS

L MEIROVITCH and H OZ (Virginia Polytechnic Institute and State University, Blacksburg, VA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 692-699 refs

(Contract NSF PFR-80-20623)

This paper presents a method for discrete-time control and estimation applicable to flexible structures in the presence of actuators and sensors noise The approach consists of complete decoupling of the modal plant and estimator dynamics based on the independent modal-space control (IMSC) technique and modal spatial filtering of the system output The solution for the Kalman filter gains reduces to that of independent second-order modal estimators, thus permitting real-time computation for digital control of distributed-parameter systems in a noisy environment The method can control and estimate any number of modes without computational restraints and is theoretically free of observation spillover Two examples, the first using nonlinear, quantized control and the second using linear, state feedback control are presented (Author)

A83-24755

OPTIMAL CONTROL OF FLEXIBLE STRUCTURES

J S GIBSON and M NAVID (California, University, Los Angeles, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 700, 701

A technique is presented for construction of a finite dimensional compensator that yields a nonzero stability margin in a closed-loop system, with attention given to applications in a class of infinite dimensional systems with uncoupled modes An optimal closed-loop system is approximated, with an accompanying infinite dimensional compensator M S K

A83-24756

QUALITATIVE STABILITY OF LARGE SPACE STRUCTURES WITH NONCOLOCATED ACTUATORS AND SENSORS

R GRAN (Grumman Aerospace Corp , Research Dept , Bethpage, NY) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 702, 703

The use of noncolocated sensors and actuators for controlling a large space structure introduces a serious difficulty Because of the phase shift introduced by the sign reversal when the sensor is on one side of a mode and the actuator is on the other, the mode is easily driven unstable These characteristics can be deduced easily by looking at the mode shapes and the locations of the actuator and sensor for that particular mode Thus a qualitative stability of the mode is given by a cursory inspection These are defined for the modes as stably interacting when the mode phase shift is zero and unstably interacting when the mode phase shift is 180 deg (Author)

A83-24757

SINGULAR VALUE ANALYSIS OF THE MODEL ERROR SENSITIVITY SUPPRESSION TECHNIQUE

J L TIETZE (Boeing Aerospace Co , Seattle, WA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 704, 705

The model error sensitivity suppression (MESS) technique has recently been advanced as a way to design reduced-order controller-estimators for high-order systems (Sesak et al , 1979) Reference is made to a study by Kammer and Sesak (1979) which examined the parameter sensitivity of a specific model-MESS design when three or four actuator/sensor pairs are available An analysis of the return difference matrix was used to explain why the four-actuator designs were superior to the three-actuator designs A singular value analysis of the return difference matrix is used here to demonstrate a similar conclusion C R

A83-24758

EXPERIMENTAL RESULTS FOR ACTIVE STRUCTURAL CONTROL

J N AUBRUN, J A BREAKWELL, and G J CHAMBERS (Lockheed Research Laboratories, Palo Alto, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 706-709 Research supported by the Lockheed Independent Research Program

(Contract F30602-81-C-0102)

Experimental verification of control strategies for large space structures is described One experiment deals with Low Authority Control and uses a vertically suspended flexible beam for which two-dimensional bending modes are controlled The second experiment deals with Modern Optical Digital Control and uses a horizontal composite flexible beam Rotational and translational modes are controlled (Author)

A83-24759* Jet Propulsion Lab , California Inst of Tech , Pasadena

A FUNCTION SPACE APPROACH TO SMOOTHING WITH APPLICATIONS TO MODEL ERROR ESTIMATION FOR FLEXIBLE SPACECRAFT CONTROL

G RODRIGUEZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 710-713 NASA-supported research

A function space approach to smoothing is used to obtain a set of model error estimates inherent in a reduced-order model By establishing knowledge of inevitable deficiencies in the truncated model, the error estimates provide a foundation for updating the model and thereby improving system performance The function space smoothing solution leads to a specification of a method for computation of the model error estimates and development of model error analysis techniques for comparison between actual and estimated errors The paper summarizes the model error estimation approach as well as an application arising in the area of modeling for spacecraft attitude control (Author)

A83-24760

DISCRETE LARGE SPACE STRUCTURE CONTROL SYSTEM DESIGN USING POSITIVITY

R J BENHABIB (TRW Defense and Space Systems Group, Redondo Beach, CA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 715-724 refs

Because of the cost and flexibility advantages offered by microprocessors, any control system to be considered for Large Space Structures (LSS) will likely be digital A combined positivity and W-plane, frequency domain design procedure for synthesizing the control of these structures is proposed Positivity theory is used to ensure the stability and stability robustness of digital designs, inclusive of modal truncation and aliasing Shaping the characteristic gains in an alpha-shifted W-plane synthesizes the required performance The combined approach has the advantage that it leads directly to robust and implementable low-order controllers A design example using an LSS like structure is provided (Author)

A83-24786
THE DECENTRALIZED CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES
G WEST-VUKOVICH, E J DAVISON, and P C HUGHES (Toronto, University, Toronto, Canada) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 949-955 Research supported by the Canada Council, National Research Council of Canada refs
(Contract NRC A-4396)
The decentralized robust servomechanism problem with constant disturbances/set points is considered in this paper for large flexible space structures (LFSS) It is shown that for LFSS with point force actuators co-located with displacement-rate sensors the decentralized fixed modes of the system are precisely equal to the centralized fixed modes of the system Simple necessary and sufficient conditions are then obtained for a solution to the robust decentralized servomechanism problem for the system A solution to the decentralized control of a 200th order LFSS model (Purdue model) is included to illustrate the results (Author)

A83-24788
CONTROLLER DESIGN FOR ASYMPTOTIC STABILITY OF FLEXIBLE SPACECRAFT
S N SINGH (Santa Catarina, Universidade Federal, Florianopolis, Brazil) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p 961-966 refs
Several linear and nonlinear state variable feedback control laws for ensuring global asymptotic stability of the equilibrium state of a large flexible spacecraft are derived using invariance principles The stabilizing control laws are derived using the Hamiltonian of the system as an appropriate Liapunov function Necessary and sufficient conditions for the existence of the stabilizing controller are formulated It is shown that the stabilizing control law exists if and only if certain observability conditions are satisfied A simple test for control laws ensuring global asymptotic stability is developed using modal decomposition based on a simplified observability condition In addition, an example of the application of this method to a specific spacecraft model is presented N B

A83-24792* Cornell Univ , Ithaca, N Y
PROBLEMS IN THE APPLICATION OF MULTIVARIABLE ADAPTIVE CONTROL TO FLEXIBLE SPACECRAFT
D A LAWRENCE and C R JOHNSON, JR (Cornell University, Ithaca, NY) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 3 New York, Institute of Electrical and Electronics Engineers, 1981, p 990, 991 refs
(Contract NAG1-7)
The present investigation is concerned with the application of adaptive control to distributed parameter systems (DPS) which arise in the modeling of large space structures (LSS) Distributed parameter and multivariable models for LSS are introduced and the decoupled adaptive control of such models is considered Possibilities to achieve adaptive control in connection with a more general model are also examined It is found that, in concept, adaptive control appears to be a natural choice for solving attitude and shape perturbation problems in LSS However, due to the distributed parameter nature of such structures and the current lack of experience in their control, the problem must be phrased in general terms which are very difficult to deal with In particular, detailed a priori plant knowledge is currently required so that decoupling and/or reduced order models of sufficient accuracy can be provided G R

A83-24819
CLOSED-LOOP ASYMPTOTIC STABILITY AND ROBUSTNESS CONDITIONS FOR LARGE SPACE SYSTEMS WITH REDUCED-ORDER CONTROLLERS
J G LIN (Charles Stark Draper Laboratory, Inc , Cambridge, MA) In Conference on Decision and Control, 20th, and Symposium on Adaptive Processes, San Diego, CA, December 16-18, 1981, Proceedings Volume 3 New York, Institute of Electrical and Electronics Engineers, 1981, p 1497-1502 refs
(Contract F30602-80-C-0096)
Various conditions useful for ensuring full-order closed-loop (FOCL) asymptotic stability are presented These conditions, and the insight derived therefrom, are useful as a guide to the FOCL asymptotic stability necessary for designs of reduced-order feedback controllers The large space systems considered are not limited to the class of large space structures, the possible presence of rigid or unstable modes is not excluded For the common class of large space structures with only stable (elastic or rigid) modes, simpler conditions especially useful for ensuring FOCL asymptotic stability are also given Also presented are conditions for robustness of FOCL asymptotic stability to parameter errors C R

A83-25029
ON THE FASTEST REORIENTATION OF THE AXIS OF ROTATION OF A DYNAMICALLY SYMMETRIC SPACECRAFT [O NAISKOREISHEI PEREORIENTATSII OSI VRASHCHENIIA DINAMICHESKI SIMMETRICHNOGO KOSMICHESKOGO APPARATA]
IU N GORELOV Kosmicheskie Issledovaniia, vol 21, Jan -Feb 1983, p 27-33 In Russian refs
The paper examines the variational problem of the minimum-time reorientation of the dynamic-symmetry axis (which is also the axis of rotation) of a spacecraft, the solution being sought in a class of motions with one turn of this axis Before and after the turn, the angular velocity is assumed to be unchanged, while the axis of rotation is assumed to be fixed in inertial space The control is executed by two systems of engines a turning system that produces a control moment in the equatorial plane of the spacecraft and a fixed system controlling the angular velocity of the spacecraft's rotation about the symmetry axis The optimal control is determined under the assumption that the angular velocity is controlled in the course of the maneuver B J

A83-25042
DEPLOYMENT OF A LONG-TETHERED CONNECTION BETWEEN TWO BODIES IN ORBIT [O RAZVERTYVANII PROTIAZHENNOI SVIAZI DVUKH TEL NA ORBITE]
E M LEVIN Kosmicheskie Issledovaniia, vol 21, Jan -Feb 1983, p 121-124 In Russian refs
A sufficiently simple method is described for the deployment of a long-tethered satellite system in elliptical orbit A class of motions of a variable-length tether is examined Equations are derived for describing horizontal oscillations of the probe (the tethered body) near the vertical-drift regime in the orbit plane and for oscillations in the direction of the normal to the orbit plane B J

A83-25048
A POWERED GYROSCOPE WITH ELECTROMAGNETIC BEARINGS FOR THE ATTITUDE CONTROL OF ORBITAL STATIONS [SILOVOI GIROSKOP S ELEKTROMAGNITNYMI PODSHIPRIKAMI DLIA UPRAVLENIIA ORIENTATSIEI ORBITAL'NYKH STANTSEI]
N N SHEREMETEVSKII, D M VEINBERG, V P VERESHCHAGIN, and N N DANILOV-NITUSOV Kosmicheskie Issledovaniia, vol 21, Jan-Feb 1983, p 139-142 In Russian
Investigations have been carried out which point to the feasibility of using an electromagnetic suspension in large powered gyroscopes intended for the production of large control moments in attitude control systems Attention is given to the basic parameters of this type of electromagnetic bearing, techniques of bearing control, and magnetic bearings for a gyrodyne It is concluded that electromagnetic bearings should be suitable for use in the powered gyroscope systems of large long-operating orbital stations B J

A83-25504#
GEOSTATIONARY SATELLITE ORBITAL GEOMETRY AND COVERAGE AREA VARIATIONS DUE TO THE ATTITUDE CONTROL ERRORS
P BENI (CNR, Istituto di Ricerca sulle Onde Elettromagnetiche, Florence, Italy) Alta Frequenza, vol 52, Jan-Feb 1983, p 56-61
The relations concerning the satellite-observer-satellite geometry for the geostationary orbit are presented Two nomograms which allow rapid determination of the localization angles of the satellite, for an observer on the earth's surface, and from the satellite of points on earth's surface are reported Some results on the satellite coverage area variations obtained simulating errors in its attitude control system are discussed (Author)

A83-26586
AN APPLICATION OF ROBUST SERVOMECHANISMS TO CONTROL OF FLEXIBLE STRUCTURES. I - MODELLING AND SYNTHESIS
A A GOLDENBERG (Spar Aerospace Ltd, Control Systems Dept, Toronto, Canada) In Control science and technology for the progress of society, Proceedings of the Eighth Triennial World Congress, Kyoto, Japan, August 24-28, 1981 Volume 4 Part B Oxford, Pergamon Press, 1982, p 2237-2244 refs
Control of interactions between attitude control system for a three-axis stabilized geosynchronous satellite and a large solar array drive and track system is discussed The problem considered is to find a controller such that the closed loop system provides regulation of the attitude angle (only motion about pitch axis is considered) independently of torque disturbances induced by the solar array sun-tracking motion The controller is synthesized using a robust servomechanism structure The robust design ensures that modelling errors and a large class of parameter perturbations are not affecting the performance of the attitude controller The paper indicates that asymptotic rejection of the disturbance torque for any perturbation of the given class in system parameters can be obtained if a certain model of the disturbance torque is incorporated in the attitude controller structure (Author)

A83-26587
A SENSITIVITY ANALYSIS OF MODAL CONTROLLER FOR FLEXIBLE SPACE STRUCTURES
T KIDA, O OKAMOTO, and Y OHKAMI (National Aerospace Laboratory, Chofu, Tokyo, Japan) In Control science and technology for the progress of society, Proceedings of the Eighth Triennial World Congress, Kyoto, Japan, August 24-28, 1981 Volume 4 Part B Oxford, Pergamon Press, 1982, p 2245-2250 refs
A modal controller is designed for attitude control of a class of large flexible space structures via the Simon-Mitter pole allocation method The sensitivity characteristics of the closed loop system are investigated when the space structure changes its vibrational features typified by the modal frequency This investigation is based on a linear approximation of the sensitivity matrix, which does not need the closed loop eigenvectors A primitive modeling problem for the finite element analysis and coordinate transformation procedures are also briefly described An illustrative example of a test vehicle with two vibration modes demonstrates the validity and usefulness of the proposed design and analysis methods (Author)

A83-27341
OPTIMAL SOLAR PRESSURE ATTITUDE CONTROL OF SPACECRAFT. I - INERTIALLY-FIXED ATTITUDE STABILIZATION. II - LARGE-ANGLE ATTITUDE MANEUVERS
K C PANDE (Indian Institute of Technology, Kanpur, India) and R VENKATACHALAM Acta Astronautica, vol 9, Sept 1982, p 533-545 Research supported by the Indian Space Research Organization refs
The first part of the present paper relates the development of a solar pressure control system achieving arbitrary, inertially fixed attitudes in nonspinning axisymmetric spacecraft, which consists of two rotatable mirror-like surfaces The control strategy adopted uses nominal control to counter gravitational torques, and optimal feedback control to stabilize the system The validity of the system is established for all times of the year, and in orbits encountering the earth's shadow In the second part of the paper, controller capabilities are extended to large angle attitude spacecraft maneuvers A sequential application of the control policies allows the controller to achieve any desired change, followed by stabilization along the target's orientation O C

A83-28169
ON BOARD COMPUTING - INTELLIGENT MODULES ADD A NEW DIMENSION TO SATELLITE CONTROL SYSTEMS
P J WADNER and A D KING-SMITH (British Aerospace, Space and Communications, Div, Stevenage, Herts, England) Aerospace Dynamics, Jan 1982, p 23-29
The use of sophisticated computers as essential components of space satellites is discussed, focusing on the development of the first generation multiprocessing system being developed for the UK Large Satellite (L-Sat) This system is based on an interchangeable spacecraft microcomputer module (SMM) with an ultra-reliable serial data bus for intermodule communication This system utilizes a specialized operating system for the software unlike conventional operating systems found in normal scientific computers The hardware and software for this computer system are examined in detail The main applications for the SMM are service module, or housekeeping functions on commercial satellites In addition, an application study designed to demonstrate the capabilities of the SMM and to help identify any problems in applying the hardware and software to real applications is discussed N B

A83-28421
DAMPED SECOND-ORDER RAYLEIGH-TIMOSHENKO BEAM VIBRATION IN SPACE - AN EXACT COMPLEX DYNAMIC MEMBER STIFFNESS MATRIX
R LUNDEN and B AKESSON (Chalmers Tekniska Hogskola, Goteborg, Sweden) International Journal for Numerical Methods in Engineering, vol 19, Mar 1983, p 431-449 refs
A comprehensive formulation of the damped second-order Rayleigh-Timoshenko beam vibration theory is presented A uniform linear beam performs stationary harmonic damped nonsynchronous space vibration in simultaneous tension, torsion, bending, and shear in the presence of a large static axial load Hysteretic and viscous dampings of the beam material and ambient medium are examined, and generalized complex Kolousek functions are obtained A 12 x 12 complex symmetric stiffness matrix is developed for a supported beam member excited at its ends by prescribed harmonic translations and rotations which have the same frequency but may be out of phase An exact analysis of nonproportionally damped built-up beam structures can be obtained using this matrix, thus avoiding assumed mode shapes and lumped or consistent masses The formulation is arranged so as to facilitate a rational computer coding for space frame analysis and a consistent nomenclature is developed Good agreement is obtained between

numerically calculated and experimentally measured results for several examples The stiffness matrix is incorporated in the general computer program SFVIBAT-DAMP for space frame vibration analysis N B

A83-28544

GENERATION OF SHOCK WAVES IN ONE-DIMENSIONAL SYSTEMS BY A MOVING SOURCE [IZLUCHENIE UPRUGIKH VOLN V ODNOMERNYKH SISTEMAKH DVIZHUSHCHIMSIA ISTOCHNIKOM]

S V KRYSOV and S A SIANOV PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki, Jan -Feb 1983, p 149-153 In Russian refs

The excitation of vibrations in flexible structural elements by a moving load is considered An exact solution is obtained to the problem of the excitation of bending waves in a rod by a uniformly moving periodically varying moment It is shown that, depending on the velocity of the moment, two emission regimes are possible, differing by the number of emitted waves It is noted that an increase in the number of waves is caused by the Vavilov-Cerenkov (V-C) effect Experimental results are presented on the V-C effect in flexibly coupled branches of a power transmission B J

A83-29050* National Aeronautics and Space Administration Langley Research Center, Hampton, Va

AN INVESTIGATION OF QUASI-INERTIAL ATTITUDE CONTROL FOR A SOLAR POWER SATELLITE

J -N JUANG (NASA, Langley Research Center, Hampton, VA, Martin Marietta Aerospace, Denver, CO) and S J WANG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Space Solar Power Review (ISSN 0191-9067), vol 3, no 4, 1982, p 337-352 refs

(Contract NAS7-100)

An efficient means, a quasi-inertial attitude mode, is developed for maintaining the normal solar orientation of a space satellite for power collection in a synchronous orbit Formulae are presented which establish the basic parametric properties for ideal quasi-inertial attitude and phasing An active control system is necessary to compensate for the energy loss since energy dissipation in widely oscillating flexible bodies produces an instability of the quasi-inertial attitude in the sense that the spacecraft will tumble at the orbit rate A fixed terminal time and state optimal control problem is formulated and an algorithm for determining the optimal control as a means for the periodical attitude and phase compensation is developed The vehicle orientation affected by internal disturbance (structural flexibility) and external disturbances (e g , drag forces) is maintained by a specialized controller design N B

A83-29768*# Naval Postgraduate School, Monterey, Calif

A ROBUST FEASIBLE DIRECTIONS ALGORITHM FOR DESIGN SYNTHESIS

G N VANDERPLAATS (U S Naval Postgraduate School, Monterey, CA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 392-399 NASA-supported research refs

(AIAA 83-0938)

A nonlinear optimization algorithm is developed which combines the best features of the Method of Feasible Directions and the Generalized Reduced Gradient Method This algorithm utilizes the direction-finding sub-problem from the Method of Feasible Directions to find a search direction which is equivalent to that of the Generalized Reduced Gradient Method, but does not require the addition of a large number of slack variables associated with inequality constraints This method provides a core-efficient algorithm for the solution of optimization problems with a large number of inequality constraints Further optimization efficiency is derived by introducing the concept of infrequent gradient calculations In addition, it is found that the sensitivity of the optimum design to changes in the problem parameters can be obtained using this method without the need for second derivatives or Lagrange multipliers A numerical example is given in order to demonstrate the efficiency of the algorithm and the sensitivity analysis N B

A83-29804*# Purdue Univ , Lafayette, Ind

MODELING GLOBAL STRUCTURAL DAMPING IN TRUSSES USING SIMPLE CONTINUUM MODELS

C T SUN (Purdue University, West Lafayette, IN) and J N JUANG (NASA, Langley Research Center, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 722-729 refs

(AIAA 83-1008)

Truss beams with members having viscous damping are modeled as continuum Timoshenko beams Procedures for deriving the equivalent beam stiffnesses and damping are presented The global damping for the continuum beam is explicitly expressed in terms of the damping coefficients of the individual truss members The continuum beam model is used to study transient vibration problems and the solutions are compared well with the full scale finite element solutions The gradient method is used for parameter estimations in conjunction with the Timoshenko beam model It is shown that the Timoshenko beam model can be easily updated with measured data and the updated model can yield very accurate transient solutions Author

A83-29810*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

A STUDY OF THE EFFECTS OF A CUBIC NONLINEARITY ON A MODERN MODAL IDENTIFICATION TECHNIQUE

L G HORTA and R HANKS (NASA, Langley Research Center, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 28-34 refs

(AIAA 83-0810)

The effect of a geometric nonlinearity on the Ibrahim Time Domain (ITD) modal data analysis technique has been studied using two analytically derived models and one laboratory model Response data for the three models were analyzed by the ITD method Indicators of nonlinear response were found which include harmonically related frequencies with repetitive mode shapes, clusters of frequencies in a narrow band around each harmonic, and variations in frequency with amplitude of oscillation Also,for the cases studied, the presence of a nonlinearity has no detrimental effect on identifying linear responses A potential for applying the algorithm to the identification of a certain class of nonlinear system was indicated Author

A83-29818*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

ON THE DYNAMIC RESPONSE AND COLLAPSE OF SLENDER GUYED BOOMS FOR SPACE APPLICATION

J M HOUSNER and W K BELVIN (NASA, Langley Research Center, Structures and Dynamics Div , Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 92-101 refs

(AIAA 83-0821)

A procedure is developed for the analysis of the nonlinear transient response of an initially imperfect slender guyed boom having a concentrated mass at the tip The analysis is compared with laboratory experiments, and the validated procedure is employed to study the transient response of a boom to suddenly applied step loads and prescribed initial velocities Both cases approximate the transient conditions associated with commencing and terminating a slewing maneuver in space Two nonlinear effects are examined, namely cable slackening and beam column behavior It is shown that dynamic buckling of the boom may occur with excitations which result in slackening of a cable It is also shown that transverse boom tip deflections are sensitive only to initial eccentricities when certain threshold values are exceeded Design guidelines are established for combinations of pulse level and duration which meet performance requirements for allowable deflections VL

A83-29819*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

VIBRATION CHARACTERISTICS OF HEXAGONAL RADIAL RIB AND HOOP PLATFORMS

W K BELVIN (NASA, Langley Research Center, Structures and Dynamics Div, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 102-110 refs

(AIAA 83-0822)

Experiment and analysis have been used to characterize the modes of vibration of planar radial rib and hoop hexagonal platforms Finite element analysis correlated very well with experimental results The sensitivity of mode shapes and frequencies to cable stiffness and initial tension is presented Threshold values have been identified, above which changes in cable stiffness do not affect the first few platform vibration modes Primary vibration modes of the radial rib platform involve beam bending Vibration modes of the hoop platform exhibit both beam bending and frame bending and torsion Results indicate for low order polygonal structures, the radial rib concept produced a higher fundamental frequency For high order polygonal structures, the hoop concept has the potential to achieve a higher fundamental frequency than the radial rib concept Author

A83-29825*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala

A PRELIMINARY LOOK AT CONTROL AUGMENTED DYNAMIC RESPONSE OF STRUCTURES

R E JEWELL and R S RYAN (NASA, Marshall Space Flight Center, Structural Dynamics Div, Huntsville, AL) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 166-173

(AIAA 83-0850)

This report deals with the augmentation of structural characteristics, mass, damping, and stiffness through the use of control theory in lieu of structural redesign or augmentation Treated first is the standard single-degree-of-freedom system followed by a treatment of the same system using control augmentation The system is extended to elastic structure using single and multisensor approaches and concludes with a brief discussion of potential application to large orbiting space structures Author

A83-29826#

BLOCK-INDEPENDENT CONTROL OF DISTRIBUTED STRUCTURES

L M SILVERBERG and L MEIROVITCH (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 174-178 refs

(Contract NSF PFR-80-20623)

(AIAA 83-0852)

As a compromise between coupled control and independent modal-space control, a block-independent control method is proposed The computational difficulties encountered in coupled control are thereby reduced significantly The requirement on the number of actuators is shown to be lower for block-independent control than for independent modal-space control, but only moderately so A numerical example is presented Author

A83-29827*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

OPTIMUM ACTUATOR PLACEMENT, GAIN, AND NUMBER FOR A TWO-DIMENSIONAL GRILLAGE

G C HORNER (NASA, Langley Research Center, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 179-184 refs

(AIAA 83-0854)

A technique for determining the best actuator locations, actuator gains, and number of actuators is presented with results obtained for a two-dimensional grillage model The technique minimizes the sum of the actuator gains and it is shown for the example studied that this minimum is constant for a large variation in the number of actuators Comparisons are made between force and torque actuators, and system stability is guaranteed throughout the design process Author

A83-29828*# Virginia Polytechnic Inst and State Univ, Blacksburg

NONLINEAR CONTROL OF AN EXPERIMENTAL BEAM BY IMSC

L MEIROVITCH, H BARUH (Virginia Polytechnic Institute and State University, Blacksburg, VA), R C MONTGOMERY, and J P WILLIAMS (NASA, Langley Research Center, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 185-192 refs

(Contract NAG1-225)

(AIAA 83-0855)

Results are reported from an experiment designed to control the vibratory motion of a beam at NASA, Langley Research Center The experimental setup consists of a free-free uniform beam acted upon by four electromagnetic force actuators, with the motion being measured by nine displacement sensors The entire assembly is linked to a CDC Cyber 175 computer which permits on-line real-time computation of the control forces The control scheme is based on Independent Modal-Space Control (IMSC), whereby the modal forces are computed using a nonlinear, on-off control law The actuator forces are then synthesized using a linear transformation, resulting in quantized forces The sensors data is processed by modal filters It is observed that the controls designed on the basis of the IMSC method are very effective in suppressing the vibratory motion of the beam, even though there is about a 50 percent differene between the actual and the analytically computed frequencies Author

A83-29829*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

CLOSE-MODE IDENTIFICATION PERFORMANCE OF THE ITD ALGORITHM

R S PAPPA (NASA, Langley Research Center, Structures and Dynamics Div, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 193-205 refs

(AIAA 83-0878)

Results of Monte Carlo numerical simulations conducted to study the close-mode performance of the Ibrahim Time-Domain (ITD) modal identification algorithm are presented The ITD technique is a matrix eigensolution method for obtaining structural modal parameters directly from free-response test data without using the FFT Thus, the well-known resolution and leakage limitations of the FFT procedure, that are particularly significant with short records, are avoided As an example, one of several experimental data analyses where close modes have been accurately identified using very short records is shown Although the identification scatter is found to increase as the square of reductions in frequency separation at small separations, the ability to differentiate modes spaced at fractions of the FFT resolution is substantiated Author

A83-29830*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

EXPERIMENTS USING LEAST SQUARE LATTICE FILTERS FOR THE IDENTIFICATION OF STRUCTURAL DYNAMICS

N SUNDARARAJAN and R C MONTGOMERY (NASA, Langley Research Center, Flight Dynamics and Control Div, Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 206-210 refs

(AIAA 83-0880)

An approach for identifying the dynamics of large space structures is applied to a free-free beam In this approach the system's order is determined on-line, along with mode shapes, using recursive lattice filters which provide a least square estimate of the measurement data The mode shapes determined are orthonormal in the space of the measurements and, hence, are not the natural modes of the structure To determine the natural modes of the structure, a method based on the fast Fourier transform is used on the outputs of the lattice filter These natural modes are used to obtain the modal amplitude time series which provides the input data for an output error parameter identification scheme that identifies the ARMA parameters of the difference equation model of the modes the approach is applied to both simulated and experimental data Author

A83-29840#

TRANSIENT RESPONSE OF DAMPED SPACE SYSTEMS

D I G JONES (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 304-313 refs

(AIAA 83-0900)

This paper discusses the modal analysis of multiple degree of freedom structural systems, such as large space structures, in free space, subject to transient excitation of the type which might arise during a maneuver The basis of the analysis is the numerical inversion of a Fourier Transform utilizing a complex modulus representation of viscoelastic material damping behavior with frequency dependent coefficients Author

A83-29862*#

A TRAVELLING WAVE APPROACH TO THE DYNAMIC ANALYSIS OF LARGE SPACE STRUCTURES

A H VON FLOTOW IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 509-519 USAF-supported research refs

(Contract NAG1-97)

(AIAA 83-0964)

This paper investigates the dynamic analysis of certain large space structures via travelling wave mathematics It is assumed that large space structures may be modelled as networks of interconnected one-dimensional structural members Bodies with a finite number of internal dynamic degrees of freedom may be scattered throughout the network The wave propagation behavior of one-dimensional continuous and periodic structural elements is investigated A scattering matrix description of junctions and discontinuities is proposed A time domain method of calculating network transient response using the wave propagation characteristics of the elements is briefly described Author

A83-29889#

INFLUENCE OF MASS REPRESENTATION ON THE MODAL ANALYSIS OF ROTATING FLEXIBLE STRUCTURES

R M LAURENSON (McDonnell Douglas Astronautics Co, St Louis, MO) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 2 New York, American Institute of Aeronautics and Astronautics, 1983, p 775-781 refs

(AIAA 83-0915)

A discussion of the modal analysis of a rotating flexible structure, including the influence of the structure's mass idealization is presented A brief discussion of the formulation of the equations of motion for the system is included to aid in understanding the origin of the various terms appearing in these equations Finite element techniques and their corresponding matrix form have been asumed to represent the flexible structure Modal analysis results are presented illustrating the influence of mass representation, finite element model fidelity, structural orientation, and rotational rate on the prediction of the dynamic characteristics of the structure Author

A83-37434* Lockheed Missiles and Space Co, Sunnyvale, Calif

SPACE TELESCOPE POINTING CONTROL

H DOUGHERTY, C RODONI (Lockheed Missiles and Space Co, Inc, Sunnyvale, CA), K TOMPETRINI, and A NAKASHIMA (Bendix Corp, Guidance Systems Div, Teterboro, NJ) IN Automatic control in space 1982, Proceedings of the Ninth Symposium, Noordwijkerhout, Netherlands, July 5-9, 1982 Oxford, Pergamon Press, 1983, p 15-24 refs

(Contract NAS8-32697)

The Space Telescope Pointing Control System is used to slew the optical axis of the telescope from one target star region of the celestial sphere to the next, and to maintain precision pointing on the target star A digital computer is employed in the processing of attitude and rate sensor data, in order to generate torque commands for the reaction wheels The System comprises four major elements a command generator, the electronic control system, attitude update processing, and momentum management Emphasis is given to control-related flexibility effects of the Space Telescope's solar cell array and vehicle, and the acquisition methodology and development testing employed, in addition to Pointing Control System design features O C

N83-10110*# Old Dominion Univ, Norfolk, Va

ATTITUDE AND VIBRATION CONTROL OF A LARGE FLEXIBLE SPACE-BASED ANTENNA

S M JOSHI Aug 1982 32 p refs

(Contract NAG1-102)

(NASA-CR-165979, NAS 1 26 165979) Avail NTIS HC A03/MF A01 CSCL 22B

Control systems synthesis is considered for controlling the rigid body attitude and elastic motion of a large deployable space-based antenna Two methods for control systems synthesis are considered The first method utilizes the stability and robustness properties of the controller consisting of torque actuators and collocated attitude and rate sensors The second method is based on the linear-quadratic-Gaussian control theory A combination of the two methods, which results in a two level hierarchical control system, is also briefly discussed The performance of the controllers is analyzed by computing the variances of pointing errors, feed misalignment errors and surface contour errors in the presence of sensor and actuator noise S L

N83-10111# Draper (Charles Stark) Lab , Inc , Cambridge, Mass
ACTIVE CONTROL OF SPACE STRUCTURES (ACOSS) ELEVEN Interim Report, May - Nov. 1981
K SOOSAAR, T H BROOKS, V N MAHAJAN, J C LIN, G J KISSELL, D R HEGG, R K PEARSON, J D TURNER, H M CHUN, and E FOGER Griffiss AFB, N Y RADC May 1982 140 p refs 2 Vol
(Contract F30602-81-C-0180)
(AD-A117596, CSDL-R-1536, RADC-TR-82-131-VOL-2) Avail NTIS HC A07/MF A01 CSCL 17H

Spacecraft control theory is investigated The selection process necessary in large space structure control system design using a truncated finite element model is described The truncated model must be selected properly and compensated explicitly for control and observation spillover, so the control system designed through this method can perform satisfactorily when implemented on the structure Proper selection requires correct classification of structural modes into primary and secondary modes Explicit compensation for truncation includes placement of actuators and sensors, synthesis of the actuator and sensor influences once they are placed on the structure, and filtering of the actuator inputs and sensor outputs Computer aided design software and acceleration output feedback control are also discussed GRA

N83-10112# Draper (Charles Stark) Lab , Inc , Cambridge, Mass
ACOSS ELEVEN (ACTIVE CONTROL OF SPACE STRUCTURES), VOLUME 1 Interim Report, May - Nov. 1981
T H BROOKS, V N MAHAJAN, J G LIN, G J KISSELL, D R HEGG, R K PEARSON, J D TURNER, H M CHUN, and E FOGER Griffiss AFB, N Y RADC May 1982 33 p refs 2 Vol
(Contract F30602-81-C-0180, ARPA ORDER 3655)
(AD-A117595, CSDL-R1536-VOL-1, RADC-TR-82-131-VOL-1) Avail NTIS HC A03/MF A01 CSCL 17H

The Active Control of Space Structures (ACOSS) Eleven contract includes three distinct areas of endeavor Simulations Extensions, HALO Optics and ACOSS This report covers the work performed in each of these areas between May and November 1981 Simulations Extension and HALO Optics are presented in Volume 1 and ACOSS is presented in Volume 2 Author (GRA)

N83-10258*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
A PARAMETRIC STUDY OF THE IBRAHIM TIME DOMAIN MODAL IDENTIFICATION ALGORITHM
R S PAPPA and S R IBRAHIM (Old Dominion Univ) *In* Shock and Vibration Information Center The Shock and Vibration Bull , Pt 3 p 43-72 May 1981 refs
Avail NTIS HC A12/MF A01 CSCL 12A

The accuracy of the Ibrahim time Domain (ITD) identification algorithm in extracting structural modal parameters from free response functions was studied using computer simulated data for 65 positions on an isotropic, uniform thickness plate, with mode shapes obtained by NASTRAN analysis Natural frequencies, were used, to study identification results over ranges of modal parameter values and user selectable algorithm constants Effects of superimposing various levels of noise onto the functions were investigated No detrimental effects were observed when the number of computational degrees of freedom allowed in the algorithm was made many times larger than the minimum necessary for adequate identification The use of a high number of degrees of freedom when analyzing experimental data, for the simultaneous identification of many modes in one computer run are suggested E A K

N83-10259# Virginia Univ , Charlottesville
EFFECTIVE DYNAMIC REANALYSIS OF LARGE STRUCTURES
B P WANG and F H CHU (RCA Astro-Electronics Div , Princeton, N J) *In* Shock and Vibration Information Center The Shock and Vibration Bull , Pt 3 p 73-79 May 1981 refs
Avail NTIS HC A12/MF A01 CSCL 20K

A dynamic reanalysis method which can be used to estimate the new natural frequencies of the structure after modificating using the modal information of the original structure is described A nonliner algebraic equation is derived and by solving this equation using either the Newton Raphson's iteration method or the bisection method will give the new natural frequencies of the structure after modification This method can be applied to the change of a linear spring, a concentrated mass, an extension member, a beam, and a plate element A group change of the above mentioned elements can be achieved by solving a set of coupled nonlinear algebraic equations The accuracy of the method can be improved by including the static deflections of the original structure at the modification locations due to a unit force at these locations to simulate the effect of higher modes of the original structure A finite element model of a 196 degree of freedom solar array panel system is used to demonstrate the effectiveness and accuracy of the method E A K

N83-10441*# Lockheed Missiles and Space Co , Palo Alto, Calif
LOW-AUTHORITY CONTROL SYNTHESIS FOR LARGE SPACE STRUCTURES Final Report
J N AUBRUN and G MARGULIES Washington NASA Sep 1982 99 p refs
(Contract NAS1-14887)
(NASA-CR-3495, NAS 1 26 3495) Avail NTIS HC A05/MF A01 CSCL 20K

The control of vibrations of large space structures by distributed sensors and actuators is studied A procedure is developed for calculating the feedback loop gains required to achieve specified amounts of damping For moderate damping (Low Authority Control) the procedure is purely algebraic, but it can be applied iteratively when larger amounts of damping are required and is generalized for arbitrary time invariant systems S L

N83-12125# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)
CONDITIONS OF ATTITUDE STABILITY FOR A FLEXIBLE SATELLITE
P T D LOURENCAO and D L FERREIRA Apr 1982 13 p refs In PORTUGUESE, ENGLISH summary Presented at the 3rd School of Appl Math , Rio de Janeiro, 15-19 Feb 1982 Submitted for publication
(INPE-2389-PRE/109) Avail NTIS HC A02/MF A01

Two different approaches to analyze the attitude stability of a satellite with flexible appendages are presented The first one uses Liapunov's direct method to obtain sufficient stability conditions in the neighborhood of trivial equilibrium position The second method consists in the numerical integration of nonlinear equations of motion The applications of the results obtained according to each method are discussed Author

N83-12127# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)
FLEXIBLE SATELLITE ORIENTATION, USING THE MODAL-ANALYSIS METHOD FOR GYROSCOPIC SYSTEMS [ESTUDO DO MOVIMENTO DE ORIENTACAO DE UM SATELITE COM APENDICES FLEXIVEIS, UTILIZANDO-SE O METODO DE ANALISE MODAL PARA SISTEMAS GIROSCOPICOS]
P T D LOURENCAO and D L FERREIRA Aug 1982 31 p refs In PORTUGUESE, ENGLISH summary Presented at the 34th Reuniao Anual da SBPC, Sao Paulo em Campinas, Brazil, 6-14 Jul 1982
(INPE-2505-PRE/186) Avail NTIS HC A03/MF A01

A procedure for the solution of the eigenvalue problems related to gyroscopic systems using the modal-analysis method is described The equations of motion represent a class of dynamic systems known as gyroscopic systems A transformation is made in the state space, which allows the decoupling of theses equations, determining the eigenvalues and eigenvector corresponding to the vibration modes of this type of system The procedure is applied to a satellite with two flexible appendages, and the eigenvalues and eigenvectors related to rotational and vibrational motions are determined Also the system time response is obtained in the form of analytical expressions This is of particular interest for on-board autonomous attitude control of satellites Author

N83-13108 California Univ, Los Angeles
SUBOPTIMAL CONTROLLER DESIGN USING FREQUENCY DOMAIN CONSTRAINTS Ph.D. Thesis
R D HEFNER 1982 186 p
Avail Univ Microfilms Order No DA8219691

The application of modern control theory to physical problems relies on the absolute fidelity of the mathematical model used to describe the physical system For large, flexible space structures, one of the most prominent sources of modeling error is the deletion of modes in the formation of the design, model This truncation arises from limitations of modeling accuracy and computational considerations in the control system synthesis process To address these problems, a method for designing a controller which is robust with respect to truncated flexible modes is described The approach involves minimization of a performance index that combines standard linear regulator penalties with robustness measures in the frequency domain The frequency domain criteria are chosen so as to sufficiently attenuate the high frequency response of the full dynamic system while maintaining the overall performance of the closed loop system Dissert Abstr

N83-13150 Columbia Univ, New York
ASPECTS OF THE DYNAMICS AND CONTROLLABILITY OF LARGE FLEXIBLE STRUCTURES Ph.D. Thesis
1982 263 p
Avail Univ Microfilms Order No DA8222423

The generation of equations of motion of a free-free beam whose overall motion is completely unrestricted is discussed It is seen that the classical theory is inadequate for the case of large rotational rates where certain nonlinear elastic assumptions come into play The beam is considered an elementary example of a "pervasively" flexible satellite in an investigation of various nominal motions of interest in spacecraft dynamics A controllability index whose overriding concern is with the fuel expended in accomplishing system regulation is defined as well as a scalar measure (the degree of controllability) whose primary importance obtains from its usefulness as a criterion for control actuator placement on large multi-dimensional systems A numerical study delineating the actuator placement problem is presented with the simply supported beam serving as the primary example Disturbance rejection is discussed and proposed as a scalar measure Dissert Abstr

N83-13486 Cincinnati Univ, Ohio
ON THE DYNAMICS OF FLEXIBLE MULTIBODY SYSTEMS Ph.D. Thesis
F A KELLY 1982 141 p
Avail Univ Microfilms Order No DA8223052

The governing equations for flexible multibody systems are formulated recursively The chain system consists of N flexible bodies in an arbitrary tree structure provided that no closed loops are formed and translation is permitted between adjoining bodies A systematic method for handling the geometry and kinematics is presented The equations of motion are then developed using Kane's dynamical equations The equations form a set of 13N nonlinear ordinary differential equations An application of the general theory to linear chains is developed and application is made to the analysis of flexibility in industrial robotic manipulators A computer procedure, DYNAFLEX, was written and applied to an industrial robot The cases studied are static deflections, quasi-static deflections and dynamic deflections of the manipulator as it executes a programmed motion Dissert Abstr

N83-13487 Cincinnati Univ, Ohio
ON THE DYNAMICS OF CONSTRAINED MULTIBODY SYSTEMS Ph.D. Thesis
J W KAMMAN 1982 183 p
Avail Univ Microfilms Order No DA82223050

The governing equations for constrained multibody systems are formulated in a manner suitable for their automated, numerical development and solution Specifically, the 'closed loop' problem of multibody chain systems are addressed The governing equations are developed by modifying dynamical equations obtained from Lagrange's form of d'Alembert's principle This modification, which is based upon a solution of the constrant equations through a 'zero eigenvalues thoerem,' is in effect a contraction of the dynamical equations The analysis given herein is most effectively used on large systems with many degrees of freedom Toward this end, a computer program UOIN-DYNOCOMBS was written which formulates and numerically integrates the governing equations The program, and hence the analytical developments, were tested with a few example problems Dissert Abstr

N83-13495*# Martin Marietta Aerospace, Denver, Colo
STRUCTURAL DYNAMICS PAYLOAD LOADS ESTIMATES Final Report
R C ENGELS Sep 1982 146 p refs
(Contract NAS8-33556)
(NASA-CR-170681, NAS 1 26 170681, MCR-82-601) Avail NTIS HC A07/MF A01 CSCL 20K

Methods for the prediction of loads on large space structures are discussed Existing approaches to the problem of loads calculation are surveyed A full scale version of an alternate numerical integration technique to solve the response part of a load cycle is presented, and a set of short cut versions of the algorithm developed The implementation of these techniques using the software package developed is discussed J D

N83-13833# Communications Research Centre, Ottawa (Ontario) Space Technology and Applications Branch
COMPUTER GRAPHICS DISPLAY OF MOTION OF A SHUTTLE-ATTACHED DIPOLE ANTENNA
F R VIGNERON and M SAVOIE Sep 1982 31 p refs
(CRC-1359) Avail NTIS HC A03/MF A01

A computer-generated animation of the dynamics of a flexible body which consists of a long dipole antenna mounted on the Shuttle is described The animation facility consists of a PDP-11/45 and a modified NORPAK incremental graphics processor (IGP) An analytical formulation, in which the antenna deformation is represented with a product series of time dependent variables and simple polynomial shape coordinates, was found to be a good choice for the animation The computer and graphics facility enabled efficient on-line animation In a mode where calculations are done off-line, speeds of 60 times faster than real time were achieved with no problems S L

N83-14154 California Univ, Los Angeles
CONTROLLER DESIGN FOR LARGE SPACE STRUCTURES USING PARAMETER OPTIMIZATION Ph.D. Thesis
M I MIYAGI 1982 415 p
Avail Univ Microfilms Order No DA8219736

Due to the large orders associated with accurate models for Large Space Structures, controller design is usually based on reduced order models Since controller complexity is linked to model size, to obtain a controller of suitable simplicity a simplified model is also required The methods of the present research are directed toward making the determination of model size independent of controller complexity This approach is characterized by its objective of minimizing a performance index or cost functional with respect to specified variables or parameters for a given controlled structure and, is often referred to as parameter optimization The first part of this research addresses the development of a self contained, efficient parameter optimization program In the second part of this research the extension of parameter optimization to include the optimization of the control or measurement distribution matrices (and, by implication, sensor and actuator placement) in addition to the output feedback gains is made Dissert Abstr

N83-14155 California Univ, Los Angeles
ROBUST CONTROL SYSTEM DESIGN TECHNIQUES FOR LARGE FLEXIBLE SPACE STRUCTURES HAVING NONCOLOCATED SENSORS AND ACTUATORS Ph.D. Thesis
R S EDMUNDS 1982 123 p
Avail Univ Microfilms Order No DA8219676

The problem of designing robust controllers for elastic systems having non-colocated actuators and sensors addressed Controllers are found which minimize output error subject to robustness and control effort constraints An integrated design method is presented which addresses structural/controller modeling and controller design Reduced order models of the structure are selected for stability and performance analysis Optimal controller designs are found for low order models which meet robustness and control effort constraints These designs are evaluated using frequency domain methods, and suboptimal designs are found which retain robustness and improve performance The resulting suboptimal designs are evaluated using a higher order model and, if necessary, adjusted to ensure that robustness and control effort constraints are satisfied The design method is illustrated by example Dissert Abstr

N83-14520 Iowa Univ, Iowa City
THREE DIMENSIONAL RIGID BODY DYNAMICS USING EULER PARAMETERS AND ITS APPLICATION TO STRUCTURAL COLLAPSE MECHANISMS Ph.D. Thesis
I S CHUNG 1982 145 p
Avail Univ Microfilms Order No DA8222220

A computer-based method is presented for formulation and efficient solution of nonlinear, constrained differential equations of motion for spatial dynamic analysis of mechanical systems and its application to plastically deformable structures Nonlinear holonomic constraint equations and differential equations of motion are written in terms of maximal set of Cartesian generalized coordinates There are three translational and four rotational coordinates for each rigid body in the system, where the rotational coordinates are Euler parameters Euler parameters have no critical singular cases, in contrast to Euler angles or any other set of three rotational generalized coordinates The maximal set of generalized coordinates facilitates the general formulation of constraints and forcing functions A numerical integration algorithm integrates the reduced system of differential equations of motion for only independent generalized coordinates, which are constructed by the generalized coordinate partitioning scheme Several examples show validity of the formulation and accuracy of the program Dissert Abstr

N83-14536# Brown Univ, Providence, R I Center for Dynamical Systems
PARAMETER ESTIMATION IN TIMOSHENKO BEAM MODELS
H T BANKS and J M CROWLEY Jun 1982 36 p refs
(Contract DAAG29-79-C-0161, AF-AFOSR-0198-81, AF PROJ 2304)
(AD-A119234, LCDS-82-14, AFOSR-82-0721TR) Avail NTIS HC A03/MF A01 CSCL 12A

The authors present cubic and linear spline-based approximation schemes for models of beams based on the Timoshenko theory The schemes are used in parameter estimation algorithms, convergence results and numerical findings are reported Author (GRA)

N83-14723# AEG-Telefunken, Wedel (West Germany)
ANALYTICAL PREDICTION OF THE DYNAMIC IN-ORBIT BEHAVIOR OF LARGE FLEXIBLE SOLAR ARRAYS
G BEHRENS *In* ESA Photovoltaic Generators in Space p 187-192 Jun 1982 refs
Avail NTIS HC A15/MF A01

The natural motions in terms of eigenfrequencies and modes of large flexible solar arrays were determined by the finite element method (FEM) The accuracy of the FE-model was verified and improved by static and dynamic analyses Good agreement with flight test data was established Author (ESA)

N83-16061*# Massachusetts Inst of Tech, Cambridge Lab for Information and Decision Systems
ROBUSTNESS OF ADAPTIVE CONTROL ALGORITHMS IN THE PRESENCE OF UNMODELED DYNAMICS
C E ROHRS, L VALAVANI, M ATHANS, and G STEIN Sep 1982 11 p refs Presented at the 21st IEEE Conf on Decision and Control, Orlando, Fla, Dec 1982
(Contract NGL-22-009-124, N00014-82-K-0582, AF-AFOSR-3281-77, NR PROJ 606-003)
(NASA-CR-169643, NAS 1 26 169643, AD-A119910, LIDS-P-1240) Avail NTIS HC A02/MF A01 CSCL 12A

This paper reports the outcome of an exhaustive analytical and numerical investigation of stability and robustness properties of a wide class of adaptive control algorithms in the presence of unmodeled dynamics and output disturbances The class of adaptive algorithms considered are those commonly referred to as model-reference adaptive control algorithms, self-tuning controllers, and dead-beat adaptive controllers, they have been developed for both continuous-time systems and discrete-time systems The existing adaptive control algorithms have been proven to be globally asymptotically stable under certain assumptions, the key ones being (1) that the number of poles and zeroes of the unknown plant are known, and (2) that the primary performance criterion is related to good command following These theoretical assumptions are too restrictive from an engineering point of view Real plants always contain unmodeled high-frequency dynamics and small delays, and hence no upper bound on the number of the plant poles and zeroes exists Also real plants are always subject to unmeasurable output additive disturbances, although these may be guide small Hence, it is important to critically examine the stability robustness properties of the existing adaptive algorithms when some of the theoretical assumptions are removed, in particular, their stability and performance properties in the presence of unmodeled dynamics and output disturbances GRA

N83-16062# Cincinnati Univ, Ohio Inst of Applied Interdisciplinary Research
USER'S MANUAL FOR UCIN-EULER A MULTIPURPOSE, MULTIBODY SYSTEMS DYNAMICS COMPUTER PROGRAM Technical Report, 1 Jul. 1977 - 1 Sep. 1982
R L HUSTON, M W HARLOW, and N L GAUSEWITZ Sep 1982 52 p refs
(Contract N00014-76C-0138, NSF ENG-75-21037, NSF MEA-81-01110)
(AD-A120403, ONR-UC-MIE-090182-14) Avail NTIS HC A04/MF A01 CSCL 09B

This is a User's Manual for the computer program UCIN-EULER The program is designed and developed to study the dynamics of multibody systems The multibody systems encompassed by EULER are systems of linked rigid bodies with no closed loops, such as robot arms, chains, antennas, manipulators, and human body models The manual provides instruction for using EULER to study multibody system dynamics It also provides sample input and output data Input procedures and commands are expressed in terms of keywords in order to make the program useful and readily accessible to even the casual user Author (GRA)

N83-16380# California Univ, Los Angeles Dept of System Science
APPROXIMATION OF THE OPTIMAL COMPENSATOR FOR A LARGE SPACE STRUCTURE Interim Report, 30 Jun. 1981 - 1 Jul. 1982
M K MACKAY 1982 24 p refs Presented at the Workshop on Applications of Distributed System Theory to the Control of Large Space Structures, Pasadena, Calif, 14-16 Jul 1982
(Contract AF-AFOSR-3550-78, AF PROJ 2304)
(AD-A120246, AFOSR-82-0849TR) Avail NTIS HC A02/MF A01 CSCL 09C

This paper considers the approximation of the optimal compensator for a large Space Structure The compensator is

based upon a solution to the Linear Stochastic Quadratic Regulator problem Colocation of sensors and actuators is assumed A small gain analytical solution for the optimal compensator is obtained for a single input/single output system, i e, certain terms in the compensator can be neglected for sufficiently small gain The compensator is calculated in terms of the kernal to a Volterra integral operator using a Neumann series The calculation of the compensator is based upon the C sub o semigroup for the infinite dimensional system A finite dimensional approximation of the compensator is, therefore, obtained through analysis of the infinite dimensional compensator which is a compact operator
Author (GRA)

N83-16785*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

VIBRATION STUDIES OF A LIGHTWEIGHT THREE-SIDED MEMBRANE SUITABLE FOR SPACE APPLICATION

J L SEWELL, R MISERENTINO, and R S PAPPA Jan 1983 49 p refs
(NASA-TP-2095, L-15247, NAS 1 60 2095) Avail NTIS HC A03/MF A01 CSCL 20K

Vibration studies carried out in a vacuum chamber are reported for a three-sided membrane with inwardly curved edges Uniform tension was transmitted by thin steel cables encased in the edges Variation of ambient air pressure from atmospheric to near vacuum resulted in increased response frequencies and amplitudes The first few vibration modes measured in a near vacuum are shown to be predictable by a finite element structural analysis over a range of applied tension loads The complicated vibration mode behavior observed during tests at various air pressures is studied analytically with a nonstructural effective air-mass approximation The membrane structure is a candidate for reflective surfaces in space antennas M G

N83-17361*# Alabama Univ, University Dept of Mathematics

CONTROL POLE PLACEMENT RELATIONSHIPS

O R AINSWORTH *In* NASA Marshall Space Flight Center The 1982 NASA/ASEE Summer Fac Fellowship Program 12 p Aug 1982 refs
Avail NTIS HC A99/MF A01 CSCL 12A

Using a simplified Large Space Structure (LSS) model, a technique was developed which gives algebraic relationships for the unconstrained poles The relationships, which were obtained by this technique, are functions of the structural characteristics and the control gains Extremely interesting relationships evolve for the case when the structural damping is zero If the damping is zero, the constrained poles are uncoupled from the structural mode shapes These relationships, which are derived for structural damping and without structural damping, provide new insight into the migration of the unconstrained poles for the CFPPS Author

N83-17376*# Tulsa Univ, Okla Dept of Electrical Engineering

SHAPE CONTROL OF LARGE SPACE STRUCTURES

M T HAGAN *In* NASA Marshall Space Flight Center The 1982 NASA/ASEE Summer Fac Fellowship Program 28 p Aug 1982 refs
Avail NTIS HC A99/MF A01 CSCL 22B

A survey has been conducted to determine the types of control strategies which have been proposed for controlling the vibrations in large space structures From this survey several representative control strategies were singled out for detailed analyses The application of these strategies to a simplified model of a large space structure has been simulated These simulations demonstrate the implementation of the control algorithms and provide a basis for a preliminary comparison of their suitability for large space structure control Author

N83-17380*# Washington State Univ, Pullman Dept of Mechanical Engineering

FINITE ELEMENT ANALYSIS OF A DEPLOYABLE SPACE STRUCTURE

D V HUTTON *In* NASA Marshall Space Flight Center The 1982 NASA/ASEE Summer Fac Fellowship Program 20 p Aug 1982 refs
Avail NTIS HC A99/MF A01 CSCL 20K

To assess the dynamic characteristics of a deployable space truss, a finite element model of the Scientific Applications Space Platform (SASP) truss has been formulated The model incorporates all additional degrees of freedom associated with the pin-jointed members Comparison of results with SPAR models of the truss show that the joints of the deployable truss significantly affect the vibrational modes of the structure only if the truss is relatively short Author

N83-18822*# Integrated Systems, Inc, Palo Alto, Calif

CONTROL OF LARGE SPACE STRUCTURES: STATUS REPORT ON ACHIEVEMENTS AND CURRENT PROBLEMS

M G LYONS and J N AUBRUN (Lockheed Palo Alto Research Lab) *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 55-72 Feb 1983
Avail NTIS HC A10/MF A01 CSCL 22B

The objectives, state-of-the-art, and problems of large space structures control are outlined The general objectives range from basic deployment and maneuvering, where some vibration modes may be suppressed, to disturbance rejection for very high performance imaging applications The controls selected generally must produce some combination of eigenvalue/eigenvector and loads modification in order to achieve the mission objectives An experiment illustrating the dynamic control of a suspended circular plate is described Analysis methods used in system modelling, signal processing, and process control and monitoring are discussed Sensor and actuator performance are assessed
M G

N83-18824*# Virginia Polytechnic Inst and State Univ, Blacksburg Dept of Engineering Science and Mechanics

A COMPUTATIONAL APPROACH TO THE CONTROL OF LARGE-ORDER STRUCTURES

L MEIROVITCH *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 99-112 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B

The independent modal space control (IMSC) method is described and compared with the coupled controls method Although the coupled controls require fewer actuators, the IMSC provides larger choice of control techniques, including nonlinear control, lower computational effort, lower computer storage requirement, lower control energy, provable robustness, and actuator location flexibility M G

N83-18827*# Purdue Univ, Lafayette, Ind School of Aeronautics and Astronautics

ALGORITHM DEVELOPMENT FOR THE CONTROL DESIGN OF FLEXIBLE STRUCTURES

R E SKELTON *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 151-176 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B

The critical problems associated with the control of highly damped flexible structures are outlined The practical problems include high performance, assembly in space, configuration changes, on-line controller software design, and lack of test data Underlying all of these problems is the central problem of modeling errors To justify the expense of a space structure, the performance requirements will necessarily be very severe On the other hand, the absence of economical tests precludes the availability of reliable data before flight A design algorithm is offered which (1) provides damping for a larger number of modes than the optimal attitude controller controls, (2) coordinates the rate of feedback design with the attitude control design by use of a similar cost function, and (3) provides model reduction and controller reduction decisions which are systematically connected to the mathematical statement of the control objectives and the disturbance models M G

N83-18828*# Draper (Charles Stark) Lab, Inc, Cambridge, Mass
OPTIMAL LARGE-ANGLE MANEUVERS WITH VIBRATION SUPPRESSION
J D TURNER, H M CHUN, and J L JUNKINS (Virginia Polytechnic Inst and State Univ) *In* NASA Langley Research Center Modeling Analysis, and Optimization Issues for Large Space Struct p 177-215 Feb 1983 refs
Avail NTIS HC A10/MF A01 CSCL 22B

Some methods and applications which determine optimal maneuver controls are overviewed The main aspects of optimal control theory are summarized and the essential ideas involved in a class of methods ('continuation' or 'homotopy' methods) which are useful in solving the resulting two-point boundary value problems are discussed Several low dimensioned, nonlinear maneuvers of multiple rigid-body configurations using optimal momentum transfer are discussed Several linear and nonlinear flexible-body maneuvers are then presented and include distributed controls, vibration suppression/arrest, and computational issues Finally, the key problem areas in which future research appears most urgent are identified M G

N83-19539*# Brown Univ, Providence, R I Center for Dynamical Systems
ALGORITHMS FOR ESTIMATION IN DISTRIBUTED MODELS WITH APPLICATIONS TO LARGE SPACE STRUCTURE
H T BANKS Jul 1982 7 p refs Presented at the Workshop on Appl of Distributed System Theory to the Control of Large Space Struct, Pasadena, Calif, 14-16 Jul 1982
(Contract NAG1-258, DAAG29-79-C-0161, AF-AFOSR-0198-81)
(NASA-CR-169935, NAS 1 26 169935, AD-A121153, AFOSR-82-0927TR) Avail NTIS HC A02/MF A01 CSCL 12A

The author discusses theoretical and computational results for spline based approximation schemes used in parameter estimation algorithms for distributed systems Specific applications include beam-like structures described by the Euler-Bernoulli and Timoshenko theories and antenna surfaces such as that in the deployable Maypole Hoop/Column model GRA

N83-19805*# Virginia Univ, Charlottesville Dept of Mechanical and Aerospace Engineering
LARGE SPACE STRUCTURE DAMPING DESIGN Final Report, 16 Jan. 1981 - 15 Jan. 1983
W D PILKEY and J K HAVILAND 1983 127 p refs
(Contract NAG1-137)
(NASA-CR-170020, NAS 1 26 170020, UVA/528201/MAE83/101) Avail NTIS HC A07/MF A01 CSCL 22B

Several FORTRAN subroutines and programs were developed which compute complex eigenvalues of a damped system using different approaches, and which rescale mode shapes to unit generalized mass and make rigid bodies orthogonal to each other An analytical proof of a Minimum Constrained Frequency Criterion (MCFC) for a single damper is presented A method to minimize the effect of control spill-over for large space structures is proposed The characteristic equation of an undamped system with a generalized control law is derived using reanalysis theory This equation can be implemented in computer programs for efficient eigenvalue analysis or control quasi synthesis Methods to control vibrations in large space structure are reviewed and analyzed The resulting prototype, using electromagnetic actuator, is described Author

N83-19976*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
PARAMETER ESTIMATION FOR STATIC MODELS OF THE MAYPOLE HOOP/COLUMN ANTENNA SURFACE
H T BANKS (Brown Univ), P L DANIEL (Southern Methodist Univ), and E S ARMSTRONG Aug 1982 6 p refs Presented at the IEEE Intern Large Scale Systems Symp, Virginia Beach, Va, 11-13 Oct 1982
(Contract NAS1-15810, NAS1-16394, NAG1-258, AF-AFOSR-0198-81, NSF MCS-82-05355, NSF MCS-82-00883, AF PROJ 2304)
(NASA-TM-85172, NAS 1 15 85172, AD-A121464, AFOSR-82-0929TR) Avail NTIS HC A02/MF A01 CSCL 12A

The authors discuss theoretical and numerical results for spline based approximation schemes employed in parameter estimation algorithms for static distributed systems A specific application involves estimation of parameters in models for the antenna surface in the deployable Maypole Hoop/Column antenna Author (GRA)

N83-20003*# Massachusetts Inst of Tech, Cambridge Lab for Information and Decision Systems
GUARANTEED ROBUSTNESS PROPERTIES OF MULTIVARIABLE, NONLINEAR, STOCHASTIC OPTIMAL REGULATORS
J N TSITSIKLIS and M ATHANS Feb 1983 18 p refs Presented at the 22nd IEEE Conf on Decision and Control
(Contract NGL-22-009-124)
(NASA-CR-170068, NAS 1 26 170068, LIDS-P-1283) Avail NTIS HC A02/MF A01 CSCL 09C

The robustness of optimal regulators for nonlinear, deterministic and stochastic, multi-input dynamical systems is studied under the assumption that all state variables can be measured It is shown that, under mild assumptions, such nonlinear regulators have a guaranteed infinite gain margin, moreover, they have a guaranteed 50 percent gain reduction margin and a 60 degree phase margin, in each feedback channel, provided that the system is linear in the control and the penalty to the control is quadratic, thus extending the well-known properties of LQ regulators to nonlinear optimal designs These results are also valid for infinite horizon, average cost, stochastic optimal control problems B W

N83-20281*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
A PRELIMINARY LOOK AT CONTROL AUGMENTED DYNAMIC RESPONSE OF STRUCTURES
R S RYAN and R E JEWELL Feb 1983 31 p refs
(NASA-TM-82512, NAS 1 15 82512) Avail NTIS HC A03/MF A01 CSCL 20K

The augmentation of structural characteristics, mass, damping, and stiffness through the use of control theory in lieu of structural redesign or augmentation was reported The standard single-degree-of-freedom system was followed by a treatment of the same system using control augmentation The system was extended to elastic structures using single and multisensor approaches and concludes with a brief discussion of potential application to large orbiting space structures B G

N83-22257*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ACTIVE DAMPING OF A FLEXIBLE BEAM
G C HORNER *In its* Structural Dyn and Control of Large Space Struct, 1982 p 1-8 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 20K

The development of an algorithm that will determine actuator and sensor locations on a flexible beam is discussed Large space structures will have many locations where actuators can be placed This research seeks to determine the optimum locations In addition, the best locations are determined while certain constraints are satisfied which guarantee that mission performance requirements are achieved The approach adopted is to consider actuators and sensors to be collocated so as to produce an equivalent viscous damper Ultimately, the experimental results of measuring the log decrement during free decay will correlate with the analytical predictions R J F

N83-22258*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
DECOUPLING AND OBSERVATION THEORY APPLIED TO CONTROL OF A LONG FLEXIBLE BEAM IN ORBIT
H A HAMER *In its* Structural Dyn and Control of Large Space Struct, 1982 p 9-38 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 20K

Techniques which use decoupling theory and state variable feedback to control the pitch attitude and the flexible mode amplitudes of a long, thin beam are discussed An observer based on the steady state Kalman filter was incorporated into the control design procedure in order to estimate the values of the modal state variables required for the feedback control law R J F

N83-22261*# Stanford Univ, Calif
RESEARCH ON ELASTIC LARGE SPACE STRUCTURES AS 'PLANTS' FOR ACTIVE CONTROL
H ASHLEY and A VONFLOTOW *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 73-78 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 22B

Research on active control of large space structures is discussed Intrinsic damping in monolithic metallic structures is discussed Thermal relaxation and grain boundary relaxation are discussed, as are properties of thermal damping R J F

N83-22262*# Honeywell Systems and Research Center, Minneapolis, Minn
IDENTIFICATION AND CONTROL OF SPACECRAFT
C S GREENE and M F BARRETT *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 79-90 Apr 1982
Avail NTIS HC A12/MF A01 CSCL 22B

Information on the identification and control of spacecraft is given Maximum likelihood estimation, identification accuracy issues, steady state identifiability analysis and stochastic error with process noise are among the topics addressed R J F

N83-22263*# Howard Univ, Washington, D C
THE DYNAMICS AND CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES
P M BAINUM, V K KUMAR, R KRISHNA, A S S R REDDY, and C M DIARRA *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 91-110 Apr 1983 refs
Avail NTIS HC A12/MF A01 CSCL 22B

Large, flexible orbiting systems proposed for possible use in communications, electronic orbital based mail systems, and solar energy collection are discussed The size and low weight to area ratio of such systems indicate that system flexibility is now the main consideration in the dynamics and control problem For such large, flexible systems, both orientation and surface shape control will often be required A conceptual development plan of a system software capability for use in analysis of the dynamics and control of large space structures technology (LSST) systems is discussed This concept can be subdivided into four different stages (1) system dynamics, (2) structural dynamics, (3) application of control algorithms, and (4) simulation of environmental disturbances Modeling the system dynamics of such systems in orbit is the most fundamental component Solar radiation pressure effects and orbital and gravity gradient effects are discussed R J F

N83-22264*# Virginia Polytechnic Inst and State Univ, Blacksburg Dept of Engineering Science and Mechanics
CONTROL OF STRUCTURES IN SPACE
L MEIROVITCH and H BARUN *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 111-120 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 22B

Various topics related to the control of large space structures are discussed Equations of motion for distributed systems, eigenvalue problems, modal equations, control implementation, and the Langley beam experiment are discussed R J F

N83-22265*# Old Dominion Univ, Norfolk, Va Research Foundation
ROBUST PRECISION POINTING CONTROL OF LARGE SPACE PLATFORM PAYLOADS
S M JOSHI *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 121-134 Apr 1983 refs
Avail NTIS HC A12/MF A01 CSCL 22B

Large space structure (LSS) secondary controllers to enhance inherent damping, and primary controllers for controlling rigid-body modes and structural modes are discussed It was concluded that LSS control is stable and robust and offers promise Further investigation is needed on the effects of actuator/sensor bandwidth R J F

N83-22267*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
STRUCTURAL DESIGN FOR DYNAMIC RESPONSE REDUCTION
B R HANKS *In its* Structural Dyn and Control of Large Space Struct, 1982 p 141-150 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 20K

A computer program for redesigning structural modes to reduce response has been initiated The linear regulator approach in modal coordinates has been implemented It is noted that the transformation of solution to physical structure is a major problem It is concluded that the solution of stiffness equations and damping equations can be done separately as NXN set of (matrix Riccati) equations B W

N83-22269*# Massachusetts Inst of Tech, Cambridge Dept of Aeronautics and Astronautics
COMPONENT NUMBER AND PLACEMENT IN LARGE SPACE STRUCTURE CONTROL
W E VANDERVELDE *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 161-174 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 22B

Studies are carried out to assist the designer of the control system for a large flexible space structure in his choice of how many actuators and sensors to incorporate in the system, and where to locate them on the structure The degree of controllability and minimum control energy strategy for driving the system are described B W

N83-22271*# Draper (Charles Stark) Lab, Inc, Cambridge, Mass
LARGE SPACE STRUCTURES CONTROL ALGORITHM CHARACTERIZATION
E FOGEL *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 181-194 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 12A

Feedback control algorithms are developed for sensor/actuator pairs on large space systems These algorithms have been sized in terms of (1) floating point operation (FLOP) demands, (2) storage for variables, and (3) input/output data flow FLOP sizing (per control cycle) was done as a function of the number of control states and the number of sensor/actuator pairs Storage for variables and I/O sizing was done for specific structure examples B W

N83-22272*# Draper (Charles Stark) Lab, Inc, Cambridge, Mass
PARTITIONING OF LARGE SPACE STRUCTURES VIBRATION CONTROL COMPUTATIONS
J KERNAN *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 195-200 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 22B
The vibration control of large space structures is studied It is found to be computationally demanding Distribution of the vibration control computations among central and local processors can significantly reduce the throughput required from the central processor and may also result in improved performance due to reduced transport lag B W

N83-22274*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
LARGE SPACE STRUCTURES CONTROLS RESEARCH AND DEVELOPMENT AT MARSHALL SPACE FLIGHT CENTER: STATUS AND FUTURE PLANS
H BUCHANAN *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 215-220 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 22B
Work performed in Large Space Structures Controls research and development program at Marshall Space Flight Center is described Studies to develop a multilevel control approach which supports a modular or building block approach to the buildup of space platforms are discussed A concept has been developed and tested in three-axis computer simulation utilizing a five-body model of a basic space platform module Analytical efforts have continued to focus on extension of the basic theory and subsequent application Consideration is also given to specifications to evaluate several algorithms for controlling the shape of Large Space Structures B W

N83-22275*# Houston Univ, Tex Dept of Electrical Engineering
RESEARCH ON THE CONTROL OF LARGE SPACE STRUCTURES
E D DENMAN *In* NASA Langley Research Center Structural Dyn and Control of Large Space Struct, 1982 p 221-233 Apr 1983 refs
Avail NTIS HC A12/MF A01 CSCL 22B
The research effort on the control of large space structures at the University of Houston has concentrated on the mathematical theory of finite-element models, identification of the mass, damping, and stiffness matrix, assignment of damping to structures, and decoupling of structure dynamics The objective of the work has been and will continue to be the development of efficient numerical algorithms for analysis, control, and identification of large space structures The major consideration in the development of the algorithms has been the large number of equations that must be handled by the algorithm as well as sensitivity of the algorithms to numerical errors Author

N83-22276*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ACTIVE CONTROL OF A FLEXIBLE BEAM
J P WILLIAMS *In its* Structural Dyn and Control of Large Space Struct, 1982 p 235-247 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 20K
Because of inherent low damping and high flexibility, large space structures may require some form of active control of their dynamics Because of the apparent inability to accurately model the dynamics of these structures, methods for parameter adaptive control are now being developed at Langley This approach uses a digital computer to process discrete sensor data, identify modal parameters, calculate modal control gains, and then convert the modal forces to real forces Some of the problems considered are (1) the possibility that there may be modes to control with limited amounts of hardware, and (2) the required accuracy of identified structural parameters B W

N83-22277*# Virginia Univ, Charlottesville
OPTIMAL DAMPING FOR A TWO-DIMENSIONAL STRUCTURE
W D PILKEY and B P WANG *In* NASA Langley Research Center Structual Dyn and Control of Large Space Struct, 1982 p 249-262 Apr 1983
Avail NTIS HC A12/MF A01 CSCL 20K
Criteria for selection of optimal damper locations are presented A damping synthesis problem was formulated and applied to a NASA grillage model B W

06

ELECTRONICS

Includes techniques for power and data distribution, antenna RF performance analysis, communications systems, and spacecraft charging effects

A83-11022
A HIGH VOLTAGE, HIGH POWER PULSED TWT POWER SUPPLY FOR SPACE APPLICATION
P SOPPER (Dornier System, GmbH, Friedrichshafen, West Germany) In PESC '81, Power Electronics Specialists Conference, Boulder, CO, June 29-July 3, 1981, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1981, p 302-311
The power supply presented is used to operate a pulsed TWT in a microwave experiment, which will be flown during the first Spacelab (Spaceshuttle) mission Various high voltages up to 10 KV at a pulsed power of 9 KW are provided by the supply The design features of power conversion, high voltage insulation, pulse generation and protection circuitry are described and test results are presented (Author)

A83-11066
TESTING OF A COMMUNICATIONS SATELLITE
J SARGENT and N SHIRK (General Electric Co, Space Div, Valley Forge, PA) In ICIASF '81, International Congress on Instrumentation in Aerospace Simulation Facilities, Dayton, OH, September 30, 1981, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1981, p 150-154
The general design of the DSCS III, a third generation communication satellite, is discussed along with the methods and instrumentation used to test the satellite from buildup through acceptance testing The satellite, which has a design life of 10 yr, is a three-axis stabilized synchronous orbit satellite whose body measures 6 5 feet wide (38 feet with the solar array), 6 75 feet long, and 6 5 feet high, weighing 2200 pounds On the satellite, the six SHF channels can be received via one or two earth coverage horns, or a 61-element, switchable multibeam antenna, and transmitted via one or two earth coverage horns, a gimballed high-gain reflector antenna, or one of two 19-element switchable multibeam antennas Specific test discussed include RF compatibility and radiated susceptibility testing, radiated spray testing, acoustic testing, and testing for the response to flash X-ray exposure using a specially built satellite V L

A83-11158
COMMUTATING SPOT TRANSMISSIVE LENS ANTENNA
C ORR (Texas Instruments, Inc, Dallas, TX) In NAECON 1982, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982 Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc, 1982, p 659-663
The design and fabrication of an electronically steerable solid-state transmit-only array are discussed, and the evaluation of its viability for use in space platform applications is considered The approach being developed is capable of limited earth coverage scan (+ or 3 beamwidths) without the use of phase shifters It is concluded that breadboard data obtained during the design phase

show results consistent with predicted values and indicate that overall array performance goals will be met B J

A83-13728
DEVELOPMENT OF TEAL RUBY EXPERIMENT RADIOMETRIC TEST REQUIREMENTS
W B BIRTLEY, O K KOWALLIS, L A MOLNAR, and T J WRIGHT (Rockwell International Corp, Space Operations and Satellite Systems Div, Downey, CA) In Technical issues in focal plane development, Proceedings of the Meeting, Washington, DC, April 21, 22, 1981 Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p 15-28

The Teal Ruby Experiment (TRE) sensor presents unique problems to radiometric performance testing and calibration of a mosaic infrared sensor because of the large number of resolution elements, the wide range of spectral, temporal, and flux level operating regions, and the cryogenic operating conditions This paper contains a summary of the Teal Ruby test facilities and requirements at the infrared charge-coupled device (IRCCD) detector array, zone assembly, focal plane assembly, and sensor levels Automated test facilities and capabilities are presented to highlight the development requirements and approaches to testing Key issues concern the complexity of testing, selection of test parameters, commonality of test algorithms and data presentation, data needs for acceptance testing, optimization and integration, and test equipment standards for accuracy, operating range, and contamination control (Author)

A83-17489*
POTENTIALS ON LARGE SPACECRAFT IN LEO
M J MANDELL, I KATZ, and D L COOKE (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982) IEEE Transactions on Nuclear Science, vol NS-29, Dec 1982, p 1584-1588 refs
(Contract NAS3-22826)

A system-oriented computer code is used to predict surface charging due to voltages generated within a satellite operating in the typical dense plasma environment of LEO The use of this code is demonstrated by predicting the expansion of electric fields onto a kapton surface from a pinhole over a biased conductor in a LEO environment The results are compared to a more-exact solution and experimental data (Author)

A83-17492
MEASUREMENT OF TRANSFER IMPEDANCE OF THERMAL BLANKETS
V A J VAN LINT and J W ERLER (Mission Research Corp, San Diego, CA) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982) IEEE Transactions on Nuclear Science, vol NS-29, Dec 1982, p 1601-1606
(Contract F29601-79-C-0071)

The transfer impedance and transfer admittance of single and multiple layers of thermal blanket material and of representative blankets was measured over a frequency range of interest The test fixture, theory of the test fixture response, and experimental results for checkout, single layer samples, multilayer samples, and thermal blankets are presented The transfer impedance is essentially a constant resistance with a value inversely proportional to the number of layers, up to about 30 MHz For many layers and at higher frequencies the effective transfer impedance decreases with increasing frequency This effect is due to interlayer inductance and depends on the space between layers In a typical spacecraft 12-layer sewn thermal blanket the low frequency transfer impedance is resistive, but the value is equivalent to only two layers in parallel A strong decrease with increasing frequency is observed, with an effective impedance at 300 MHz of less than about 10 percent of the 1 MHz value C D

A83-17493
ENVIRONMENTALLY INDUCED DISCHARGES IN A SOLAR ARRAY
D B SNYDER (Case Western Reserve University, Cleveland, OH) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982) IEEE Transactions on Nuclear Science, vol NS-29, Dec 1982, p 1607-1609 refs

The charging and discharging characteristics of an electrically isolated solar array segment are studied The details of the test apparatus are described, the surface voltage profiles as a function of the beam angle of incidence are discussed, and the discharge transient characteristics are presented The results from the biased array are given to provide a comparison with the floating array results A relatively slow, repetitive discharge is seen at low electron densities which releases about 10% of the charge on the array Single faster discharges are seen which release currents on the order of microamps for a few tenths of a second Minor discharges emit about 4% of the charge, while major discharges emit about 90% The slow and fast minor discharges appear to be smaller than the discharges induced by biasing the interconnects negative with respect to the cover slides C D

A83-18322* Alabama Univ, Huntsville
A THRESHOLD EFFECT FOR SPACECRAFT CHARGING
R C OLSEN (Alabama, University, Huntsville, AL) Journal of Geophysical Research, vol 88, Jan 1, 1983, p 493-499 refs
(Contract NAS8-33982)

The borderline case between no charging and large (kV) negative potentials for eclipse charging events on geosynchronous satellites is investigated, and the dependence of this transition on a threshold energy in the ambient plasma is examined Data from the Applied Technology Satellite 6 and P78-2 (SCATHA) show that plasma sheet fluxes must extend above 10 keV for these satellites to charge in eclipse The threshold effect is a result of the shape of the normal secondary yield curve, in particular the high energy crossover, where the secondary yield drops below 1 It is found that a large portion of the ambient electron flux must exceed this energy for a negative current to exist N B

A83-18621* National Aeronautics and Space Administration Langley Research Center, Hampton, Va
THE QUAD APERTURE /HOOP/COLUMN/ ANTENNA FOR ADVANCED COMMUNICATIONS MISSIONS IN THE 1990'S
L D SIKES and T G CAMPBELL (NASA, Langley Research Center, Harris Government Electronic Systems Div, Hampton, VA) In International Conference on Antennas and Propagation, 2nd, York, England, April 13-16, 1981, Proceedings Part 1 London, Institution of Electrical Engineers, 1981, p 109-111

The possibility of meeting increased demand on the communications satellite system by utilizing a single satellite placed in geosynchronous orbit for service to the U S using the 4-6 GHz band and the 12-14 GHz band is discussed To meet continental U S coverage requirements, approximately 220 spot beams 100 miles in diameter must be used An F/D of 2 0 will be used in order to eliminate coma distortion effects, meet the low off-axis scan requirement, and fulfill design tradeoffs Improvement on the best case crossover level of -9 dB can be accomplished by using a co-boresighted multiple reflector system and interleaving the beams from each offset reflector antenna Shown are the illumination surfaces and the corresponding feed arrays in the quad aperture design and the reflector/feed system configuration for simultaneous operation in the two bands C D

A83-20416#
GEOSYNCHRONOUS ENVIRONMENT FOR SEVERE SPACECRAFT CHARGING
M S GUSSENHOVEN (Boston College, Chestnut Hill, MA) and E G MULLEN (USAF, Geophysics Laboratory, Bedford, MA) Journal of Spacecraft and Rockets, vol 20, Jan -Feb 1983, p 26-34 refs
(Contract F19628-79-C-0031, F 19628-82-K-0011)
(AD-A126955, AFGL-TR-83-0089)
(Previously cited in issue 06, p 907, Accession no A82-17873)

A83-23164
ON THE ORIENTATION PRECISION OF SATELLITE SOLAR POWER STATIONS [K VOPROSU O TOCHNOSTI ORIENTIROVANIIA KOSMICHESKIKH SOLNECHNYKH ELEKTROSTANTSII]
N A ARMAND, A N LOMAKIN, and B M PARAMONOV Radiotekhnika i Elektronika, vol 28, Jan 1983, p 157-163 In Russian refs
Attention is given to various factors which determine the orientation precision of satellite solar power stations and can lead to additional losses during the microwave energy transmission These factors include absorption and scattering in the atmosphere, the imprecision in the establishment of the amplitude-phase distribution on the transmitting antenna, and frequency instability A new scheme for the interferometric monitoring of orientation precision is proposed, and the necessary length of the interferometer baseline is determined B J

A83-23464
ON THE CHOICE OF THE OPTIMAL DENSITY OF VIBRATORS FOR A RECTENNA [K VOPROSU O VYBORE OPTIMAL'NOI PLOTNOSTI VIBRATOROV REKTENNY]
G P BOIAKHCHIAN, V A VANKE, and S K LESOTA Radiotekhnika i Elektronika, vol 28, Feb 1983, p 362-365 In Russian refs
Theoretical calculations relating to the optimization of vibrator density in a rectenna system are presented with particular reference to the development of the microwave transmission system in a satellite solar power system It is shown that, when the microwave power density in the incident beam is 230 W/sq m or less, the vibrator density can be reduced to 80 per sq m when the width of the rectenna directivity pattern is 10 deg The effect of load mismatch on the rectenna efficiency is insignificant, amounting to less than 1% for a pattern width of 10 deg B J

A83-24352*# National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex
DATA SYSTEMS - OPTICAL BUS WILL CONNECT DISTRIBUTED SYSTEM
W L SWINGLE (NASA, Johnson Space Center, Houston, TX) Astronautics and Aeronautics, vol 21, Mar 1983, p 32-35
The fiber optics buses currently under consideration for the NASA space station program will have data rates of at least 20 Mb/sec The network interconnection scheme that will eventually be used is, however, uncertain A NASA-Langley effort on graph networks includes adaptive, fault-tolerant and self-correcting operations A breadboard program at NASA-Johnson includes evaluations of standard devices, called 'bus interface units', in an adaptive and fault-correcting chordal or concentric ring type of network Fiber optics would allow an evolution to wavelength modulation techniques in such systems O C

A83-24353*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
ELECTRIC POWER - LOOKING AT REGENERATIVE SYSTEMS
J L MILLER (NASA, Marshall Space Flight Center, Huntsville, AL) Astronautics and Aeronautics, vol 21, Mar 1983, p 38-41
Photovoltaic solar array technology dominates NASA space station planning for the late 1980s, although the reduction of fabrication costs and the extension of service life for such arrays remain essential goals for research and development Attention is given to concentrator arrays, in which highly reflective surfaces concentrate solar energy onto the solar cells Two types of concentrator arrays are under consideration one with a low geometric concentration ratio which after reflector losses can produce about 5 suns at the cell surface, and the other with a Cassegrainian concentrator that produces a flux level of 100 suns on the cell surface Costs are reduced from the $300/W for planar arrays to $250/W and as little as $100/W, respectively, in 1982 dollars The storage of electrical energy by means of novel battery systems is also considered O C

A83-24354*# Jet Propulsion Lab, California Inst of Tech, Pasadena
COMMUNICATIONS AND TRACKING - LIGHT AND IR WILL HELP CARRY HIGH TRAFFIC
R M DICKINSON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Astronautics and Aeronautics, vol 21, Mar 1983, p 42-45 NASA-supported research
The space station currently under consideration by NASA must simultaneously track and communicate with the many vehicles and objects surrounding it in orbit While the Space Shuttle has 23 antennas, more than 50 will be required by the space station In addition to Shuttle-compatible equipment at P, L, C, S, and Ku bands, the station system will probably incorporate Ka, W, IR and optical frequency equipment for tracking and communications A major design challenge is foreseen in the placement of separate antennas, lenses and reflectors over the station's external geometry in order to give both the overlapping fields of view required for spherical coverage and the radiation of unambiguous navigation guide beams and markers Adaptive distributed element arrays are under consideration Another approach to spherical coverage involves the use of omnidirectional antennas which both transmit and receive RF energy over a wide range of angles O C

A83-25753
A LARGE RF RADIATING MEMBRANE FOR SPACE APPLICATION
R L BOCCHICCHIO and J A QUADRINI (Grumman Aerospace Corp, Bethpage, NY) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 12th, San Diego, CA, July 19-21, 1982, SAE 16 p
(Contract F30602-79-C-0129)
(SAE PAPER 820840)
A three-layer radiating membrane has been developed for a space-based radar system The design consists of an electronic lens, planes of phased antenna elements for RF beam formation, and a ground plane for RF reflection and isolation An 84-node thermal model was used to determine temperature distributions for thermal testing and structural deformation analysis Test results show that worst case temperature gradients and excursions will result in significant, non-permanent deformation of the membrane structure For example, uncoated Kapton antenna planes will reach about 44 4 C due to degradation during a five-year mission Future research will evaluate coating materials S C S

A83-27131* Jet Propulsion Lab, California Inst of Tech, Pasadena
COMPARISON OF EVOLVING PHOTOVOLTAIC AND NUCLEAR POWER SYSTEMS FOR EARTH ORBITAL APPLICATIONS
D E ROCKEY, R M JONES, and I SCHULMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, p 70-76 refs
(Contract NAS7-100)
Photovoltaic and fission reactor orbital power systems are compared in terms of the end-to-end system power-to-mass ratios Three PV systems are examined, i e, a solid substrate with a cell array and a NiCd battery, a modified SEP array and an NiH2 battery, and a 62-micron Si cell array and a fuel cell All arrays were modeled to be 13 5% efficient and to produce 25 kW dc The SP-100 reactor consists of the heat source, radiation shield,

heat pipes to transfer thermal energy from the reactor to thermoelectric elements, and a waste heat radiator Consideration is given to system applications in orbits ranging from LEO to GEO, and to mission durations of 1, 5, and 10 yr PV systems are concluded to be flight-proven, useful out of radiation belts, and best for low to moderate power levels Limitations exist for operations where atmospheric drag may become a factor and due to the size of a large PV power supply Space nuclear reactors will continue under development and uses at high power levels and in low altitude orbits are foreseen D H K

A83-27132* TRW Defense and Space Systems Group, Redondo Beach, Calif

SOLAR ARRAY SWITCHING POWER MANAGEMENT

J E CASSINELLI, L D SMITH (TRW Defense and Space Systems Group, Redondo Beach, CA), and M VALGORA (NASA, Lewis Research Center, Cleveland, OH) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, p 77-82

Solar array power switching concepts are explored for a 250 kWe manned LEO platform, a 50-250 kWe load for an orbit transfer vehicle (OTV), and an unmanned platform with a 50 kWe load in GEO A solar array switching power management (SASPM) system is under study to satisfy the switching demands Direct connections to arrays would be implemented for voltage regulations, power distribution, and the capability of reconfiguring the arrays to meet requirements Mission characteristics that would require the power sources were explored The LEO platform was projected to use a concentrator, have no reconfigurability, use 250 NiH2 batteries, supply 80-0 Vdc to an ion drive, and have a 20-30 yr life Both GEO and OTV arrays were planar, would feature reconfigurability, and supply 800 Vdc to an ion drive NiH2 batteries would be on the OTV, while the GEO spacecraft would use AgH2 cells A block diagram of the basic switching configuration is presented D H K

A83-27144* TRW, Inc, Redondo Beach, Calif

A PERSPECTIVE OF POWER MANAGEMENT FOR LARGE SPACE PLATFORMS

D K DECKER (TRW, Inc, TRW Space and Technology Group, Redondo Beach, CA) and J GRAVES (NASA, Marshall Space Flight Center, Huntsville, AL) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 148-152

(Contract NAS8-33198)

NASA and military applications for high power spacecraft are presently being planned A perspective of autonomous power management for low earth orbit large space platforms is presented A multichannel 250 kWe utility-type power subsystem is used as a baseline system The need for automation is reviewed, based on power subsystem complexity, survivability requirements, and cost benefits On-board versus ground management is discussed with respect to these needs In addition, the utilization of autonomous power management to enable technology readiness of large complex power subsystems is described Recommendations are made for further technology thrusts (Author)

A83-27147*

DEVELOPMENT OF MANAGEMENT TECHNOLOGY FOR LARGE POWER SYSTEMS

D K DECKER, A MESSNER (TRW, Inc, TRW Space and Technology Group, Redondo Beach, CA), and J GRAVES (NASA, Marshall Space Flight Center, Huntsville, AL) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 165-170

(Contract NAS8-33198)

Autonomous power management has been proposed as a method to perform optimization of power subsystem performance in connection with the management of multikilowatt space platforms A concept for a 250-kW utility-type power subsystem was developed A Cassegrain concentrator solar array primary source is conditioned by a solar array switching unit which supplies seventeen 220 +20 Vdc power channels A power management subsystem provides the monitoring and control of the overall electrical power subsystem The discussed system concept for autonomous management of high power space platforms utilizes on-board microprocessors in a decentralized data management architecture A data bus protocol and a data bus contention resolution scheme were selected in conjunction with the dencentralized management architecture G R

A83-27148

SOLAR ARRAY POWER MANAGEMENT

W A MAGEE, R M MARTINELLI, and J H HAYDEN (Hughes Aircraft Co, Space and Communications Group, Los Angeles, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 171-174

In designing a spacecraft power bus, a number of differential factors have to be considered The present investigation is concerned with the thermal dissipation problem Approaches to limit the solar array voltage are examined, and a method is discussed to minimize the power which must be dissipated within the spacecraft Attention is given to a full shunt limiter circuit, the switching tap limiter, and the linear tap limiter The tap limiter design has been flown on a variety of satellites The full shunt limiter was also flight tested, while the switching tap limiter is in the development stage and shows promise in implementing multikilowatt power systems G R

A83-27152*# National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex

OPTIMIZATION TECHNIQUE FOR IMPROVED MICROWAVE TRANSMISSION FROM MULTI-SOLAR POWER SATELLITES

G D ARNDT and E M KERWIN (NASA, Johnson Space Center, Houston, TX) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 193-198 refs

An optimization technique for generating antenna illumination tapers allows improved microwave transmission efficiencies from proposed solar power satellite (SPS) systems and minimizes sidelobe levels to meet preset environmental standards The cumulative microwave power density levels from 50 optimized SPS systems are calculated at the centroids of each of the 3073 counties in the continental United States These cumulative levels are compared with Environmental Protection Agency (EPA) measured levels of electromagnetic radiation in seven eastern cities Effects of rectenna relocations upon the power levels/population exposure rates are also studied (Author)

A83-27153

INTEGRATION OF LARGE ELECTRICAL SPACE POWER SYSTEMS

J H HAYDEN (Hughes Aircraft Co , Space and Communications Group, El Segundo, CA) and A KIRPICH (General Electric Co , Philadelphia, PA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 199-204

Methods for combining solar/battery space power plants with space nuclear reactor power plants are discussed, noting the eventual application for a manned space station The load will have both dc and ac components, and it is expected that solar/battery power will be used in the initial growth stages of the station The battery power is regarded as a dc source only, and all power is inverted by equipment located near the end use Shunt regulation can be implemented to handle excess power, especially with regard to a concept of an expanding power supply A direct energy transfer system (DETS) is described, and involves channeling power directly to loads, with excess power radiated away by the shunt regulator Power processing controls would respond to voltage deviations A block diagram is furnished for a reliable high voltage battery modular array which would be capable of furnishing 28 kW demand If the energy source is a constant speed alternator, then constant speed operation, load leveling, and adaptation of the alternator to different voltages would be necessary M S K

A83-27156* Boeing Aerospace Co , Seattle, Wash

HIGH VOLTAGE DISTRIBUTION AND GROUNDING IN HIGH POWER SPACECRAFT

W G DUNBAR (Boeing Aerospace Co , Seattle, WA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p 217-220

(Contract NAS8-33432)

Many space missions proposed for the time period from 1985 to 2000 will require large spacecraft to support the onboard loads In some cases, large electrical power systems will be needed to supply the electrical/electronic equipment loads These electronic systems will be used for communications, radar, and experimental equipment for aid to earth's overcrowded communication systems, exploration of new energy resources, space exploration, and eventually to supplement terrestrial electric power utilities For the near term (1985-1990), some of these systems have power levels to 50 kW The long-term programs, 1990 to post-2000, could possibly have demands in the order of multimegawatts The problems which have to be solved to construct the required high-voltage power supply systems are considered Data and conceptual designs generated are found to indicate that grounding and bonding for high power systems can be accomplished in spacecraft by using either manual or automatic joining of the structural members G R

A83-27186

STATUS OF SOLID POLYMER ELECTROLYTE FUEL CELL TECHNOLOGY AND POTENTIAL FOR TRANSPORTATION APPLICATIONS

J F MCELROY and L J NUTTALL (General Electric Co , Wilmington, MA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 2 New York, Institute of Electrical and Electronics Engineers, 1982, p 667-671

The solid polymer electrolyte (SPE) fuel cell represents the first fuel cell technology known to be used operationally Current activities are mainly related to the development of a space regenerative fuel cell system for energy storage on board space stations, or other large orbiting vehicles and platforms During 1981, a study was performed to determine the feasibility of using SPE fuel cells for automotive or other vehicular applications, using methanol as the fuel The results of this study were very encouraging Details concerning a conceptual automotive fuel cell power plant study are discussed, taking into account also a layout of major components for compact passenger car installation G R

A83-27198* TRW, Inc , Redondo Beach, Calif

DEVELOPMENT OF IMPROVED HYDROGEN RECOMBINATION IN SEALED NICKEL-CADMIUM AEROSPACE CELLS

P F RITTERMAN (TRW, Inc , TRW Space and Technology Group, Redondo Beach, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 2 New York, Institute of Electrical and Electronics Engineers, 1982, p 739-745

(Contract NAS3-21253)

The identification and measurement of a hydrogen recombination mechanism in nickel-cadmium cells has made deep reconditioning on a battery basis safe and feasible Deep reconditioning has been shown to improve performance and increase life of nickel-cadmium batteries in geosynchronous orbit applications The hydrogen recombination mechanism and data supporting the mechanism are presented Parameteric cell design experiments are described which have lead to the definition of nickel-cadmium cells capable of high rate overdischarge Nickel-cadmium cells with optimum hydrogen recombination capability were successfully cycled for 7 seasons in simulation of the geosynchronous orbit regime at 75 percent depth-of-discharge with extensive midseason and end-of-season overdischarge at rates ranging from C/4 to C/20 (Author)

A83-27206* United Technologies Corp , South Windsor, Conn

ALKALINE REGENERATIVE FUEL CELL ENERGY STORAGE SYSTEM FOR MANNED ORBITAL SATELLITES

R E MARTIN, B GITLOW (United Technologies Corp , South Windsor, CT), and D W SHEIBLEY (NASA, Lewis Research Center, Cleveland, OH) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 2 New York, Institute of Electrical and Electronics Engineers, 1982, p 790-795 refs

(Contract NAS3-22234)

It is pointed out that the alkaline regenerative fuel cell system represents a highly efficient, lightweight, reliable approach for providing energy storage in an orbiting satellite In addition to its energy storage function, the system can supply hydrogen and oxygen for attitude control of the satellite and for life support A summary is presented of the results to date obtained in connection with the NASA-sponsored fuel cell technology advancement program, giving particular attention to the requirements of the alkaline regenerative fuel cell and the low-earth mission Attention is given to system design guidelines, weight considerations, gold-platinum cathode cell performance, matrix development, the electrolyte reservoir plate, and the cyclical load profile tests G R

A83-27220

NUCLEAR POWER - KEY TO MAN'S EXTRATERRESTRIAL CIVILIZATION

J A ANGELO, JR (Florida Institute of Technology, Melbourne, FL) and D BUDEN (Los Alamos National Laboratory, Los Alamos, NM) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1397-1402 refs

The evolutionary growth of requirements for space power and propulsion supplies as humans first move into near-earth space, then undertake manufacturing and colonization on other planets, and ultimately migrate to the stars depends on the development of compact power sources Nuclear reactors are candidates for delivering KW, MW, and GW levels Heat pipe thermal rejection is a valid concept into the MW class, and solid core reactors can be built beyond that range Gas-cooled, solid core reactors developed during the Rover program reached a 4 GW output for 12 min of operation The Rover design includes graphite moderators, H2 core cooling, U-235 fuel in hexagonal shaped elements, and a Be reflector barrel in the engine configuration A maximum thrust of 930 kN was attained with a 120 kg/sec flow rate A dual mode operation for power and propulsion is regarded as feasible with further development M S K

A83-27250* TRW, Inc , Redondo Beach, Calif

CASSEGRAINIAN CONCENTRATOR SOLAR ARRAY EXPLORATORY DEVELOPMENT MODULE

R E PATTERSON (TRW, Inc , Space Technology Group, Redondo Beach, CA) and W L CRABTREE (NASA, Marshall Space Flight Center, Huntsville, AL) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1589-1594 refs

A miniaturized Cassegrainian concentrator solar array concept is under development to reduce the cost of multi-kW spacecraft solar arrays A primary parabolic reflector directs incoming solar energy to a secondary, centrally mounted inverted hyperbolic reflector and down onto a solar cell mounted on an Mo heat spreader on a 0 25 mm thick Al heat fin Each unit is 12 7 mm thick, which makes the concentrator assembly roughly as thick as a conventional panel The output is 100 W/sq and 20 W/kg, considering 20% efficient Si cells at 100 suns A tertiary light catcher is mounted around the cell to ameliorate optic errors The primary reflector is electroformed Ni with protective and reflective coatings The cells have back surface reflectors and a SiO antireflective coating An optical efficiency of 80% is projected, and GaAs cells are being considered in an attempt to raise cell efficiencies to over 30% M S K

A83-27251

COMPARISON OF COMPUTER-PREDICTED AND IN-ORBIT SOLAR ARRAY PERFORMANCE FOR GEOSYNCHRONOUS COMMUNICATIONS SATELLITES

J W LYONS, III (COMSAT Laboratories, Clarksburg, MD) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1595-1600 Research sponsored by the Communications Satellite Corp and International Telecommunications Satellite Organization refs

A computer program previously developed at COMSAT Laboratories for general purpose solar array calculations has been adapted to model array performance for a number of operational geosynchronous communications satellites, such as MARISAT and INTELSAT V The modeling was accomplished by taking the current-voltage characteristics of a single solar cell and using appropriate scaling factors to model the performance of the entire solar array The predicted solar array output is then compared with actual flight performance data To date, the solar array performances show good agreement with predictions based on trapped-electron radiation damage only (Author)

A83-27252

SYNCHRONOUS ORBIT PERFORMANCE OF HUGHES AIRCRAFT COMPANY SOLAR ARRAYS - UPDATE

L J GOLDHAMMER and S W GELB (Hughes Aircraft Co , Space and Communications Group, El Segundo, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1601-1606 Research sponsored by the International Telecommunications Satellite Organization

The in-flight performances of the solar arrays on board 1 Tacsat, Intelsats IV and IVA, 3 Comstar, 3 Marisat, 3 Telesat, 3 Western Union, 2 Palapa, and 2 SBS spacecraft are compared with each other and predictions A constant daily trapped radiation equivalent fluence rate was used for each array in the calculations, together with UV degradation effects during solar flare events Per cent deviations between telemetry and predicted output were also computed The predictions were found to reside within the accuracy limits of the telemetry data The usage of a Xe solar simulator, reliable manufacturing techniques, and verifiable computer models is concluded to be accurate for predicting cell behavior in space conditions Improvements are necessary, however, to account for solar flare events, which have been an unpredictable quantity M S K

A83-27253

FLTSATCOM SOLAR ARRAY DEGRADATION

L T BAVARO and H WEINER (Aerospace Corp , Electronics and Optics Div , El Segundo, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1607-1612 refs

A method is described for calculating solar array degradation for the FLTSATCOM spacecraft The algorithm involves proper selection of data points and the computer simulation of solar array characteristic curves Flight No 1 is used to illustrate this technique along with a discussion of the uncertainty involved The basis for the computer program for modeling the array is also presented (Author)

A83-27254* Rockwell International Corp , Seal Beach, Calif

DESIGN OF LARGE, LOW-CONCENTRATION-RATIO SOLAR ARRAYS FOR LOW EARTH ORBIT APPLICATIONS

S J NALBANDIAN and E P FRENCH (Rockwell International Corp , Space Operations/Integration and Satellite Systems Div , Seal Beach, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1613-1618 refs

(Contract NAS8-34214)

A83-27255* Jet Propulsion Lab , California Inst of Tech , Pasadena

SPACE SOLAR CELL TECHNOLOGY DEVELOPMENT - A PERSPECTIVE

J SCOTT-MONCK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1619-1623 NASA-supported research refs

The developmental history of photovoltaics is examined as a basis for predicting further advances to the year 2000 Transistor technology was the precursor of solar cell development Terrestrial cells were modified for space through changes in geometry and size, as well as the use of Ag-Ti contacts and manufacture of a p-type base The violet cell was produced for Comsat, and involved shallow junctions, new contacts, and an enhanced antireflection coating for better radiation tolerance The driving force was the desire by private companies to reduce cost and weight for commercial satellite power supplies Liquid phase epitaxial (LPE) GaAs cells are the latest advancement, having a 4 sq cm area and increased efficiency GaAs cells are expected to be flight ready in the 1980s Testing is still necessary to verify production techniques and the resistance to electron and photon damage Research will continue in CVD cell technology, new panel technology, and ultrathin Si cells M S K

A83-27256

CURRENT DEVELOPMENTS IN SILICON SPACE CELLS

P A ILES (Applied Solar Energy Corp , City of Industry, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1624-1626

The technology base for current production lines of Si solar cells for space applications is reviewed, together with emerging developmental areas Sawn single-crystal cells formed with shallow junctions, narrow grids, and back surface reflectors are currently manufactured Additional features include multiple antireflection coatings, back surface fields, and efficiencies in the 12-14 5% range Thin cells with areas up to 36 sq cm are being developed, and research is proceeding on ultrapure Si starter material in order to enhance radiation tolerance Attention is being given to array interactions, with an eye to multi-kW structures Experimentation is also proceeding on welded cell contacts, larger cells, concentrator arrays to exceed 18% efficiency at 100 suns, and specialized purpose cells which are self-annealing and can withstand high temperatures MSK

A83-27257
ADVANCED CELL DESIGNS FOR WELDED ARRAYS
M N GIULIANO and J H WOHLGEMUTH (Solarex Corp, Rockville, MD) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1627-1630

The possibility of welding solar cells intended for space applications in a way that deepens the junction under the welded contact area and placing both contacts on the back of the cells is considered A eutectic bonding technique can be implemented to prevent electrical and mechanical damage to the shallow diffused junction by the production of a deeper p-n junction underneath the contact point A gold-silicon system, in use since transistors were first introduced, becomes molten above 370 C, and if an n-type dopant like P or Sb is present in the melt the recrystallized Si becomes a doped n-type Gold-clad MO or kovar tabs have proven useful as welding contacts The dual back contacts can be effected through integral feed-through holes, preferably sloped, which allows evaporated or plated metal grid contacts to flow continuously down the sides of the holes to the back metallization MSK

A83-27259
STATUS OF GAAS SOLAR CELLS FOR SPACE POWER APPLICATIONS
G S KAMATH (Hughes Research Laboratories, Malibu, CA) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 3 New York, Institute of Electrical and Electronics Engineers, 1982, p 1635-1639 refs

Manufacturing and performance characteristics of GaAs solar cells for space applications are described, with attention given to cost factors Cells for space use have a thin (AlGa)As window layer and a junction depth less than 0 5 micron, which minimize optical absorption losses and radiation damage, respectively Cell processing consists of preparation of the epitaxial cell structure, introduction of metallic contacts, and application of an antireflective coating Liquid phase epitaxy is used in the first step and can produce eighty 2 x 2 sq cm cells in one batch Efficiencies in excess of 21 5% are projected in the 1980s, with current levels exceeding 16% Reproducible cell contacts have been temperature cycle and humidity qualified for space Concentrator configurations at 100 suns boost efficiencies above 22%, and GaAs cells at 500 suns have been operated in terrestrial applications Mass production is expected to lower GaAs cell costs to equivalence with Si cell costs, and installation on satellite solar panels is expected in the near term MSK

A83-27398
SPACECRAFT CHARGING EFFECTS
R GRARD, K KNOTT, and MR PEDERSEN (ESA, Space Science Dept, Noordwijk, Netherlands) (COSPAR, IAU, IUGG, IUPAP, and URSI, International Symposium on Progress in Solar-Terrestrial Physics, 5th, Ottawa, Canada, May 17-22, 1982) Space Science Reviews, vol 34, Mar 1983, p 289-304 refs

The selection of spacecraft surface materials is generally motivated by thermal design considerations, rather than by concern over electrostatic charging phenomena which occur in various plasma environments Attention is presently given to differential charging between sunlit and shadowed insulated surfaces, a phenomenon often observed in the geostationary orbit, which can generate potential differences of several kV between adjacent surfaces and lead to both discharges and spurious telecommands caused by voltage and current transients on cable harnesses It is noted that GEOS and ISEE satellite experience has demonstrated that differential charging can be avoided by making outer surface elements conductive, and then connecting them to a common ground OC

A83-27735
SUBMILLIMETRIC HETERODYNE TECHNIQUES FOR SPACE
T DE GRAAUW (ESA, Space Science Dept, Noordwijk, Netherlands) (COSPAR and International Astronomical Union, Symposium on Advanced Space Instrumentation in Astronomy, 4th, Ottawa, Canada, May 20-22, 1982) Advances in Space Research, vol 2, no 4, 1982, p 73-78 refs

The involvement of the European Space Agency in the development of submillimeter instrumentation began in 1974 Upon a recommendation by a subgroup of the Science Advisory Committee (the Post Apollo Infrared Group), ESRO sponsored a study of the technological requirements associated with interferometric infrared astronomy Crucial items that needed further study and development were determined, and study contracts on these were awarded by ESA beginning in 1975 Initially these items were the local oscillator and the mixer, subsequently, the backend spectrometer was added It is noted that a study was recently carried out to determine crucial technical areas of a space-borne heterodyne receiver operating between 600 microns and 900 microns This development program is described here, and some of the results of the study on the space-borne heterodyne receiver are summarized CR

A83-29047* National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex
GRATING LOBE CHARACTERISTICS AND ASSOCIATED IMPACTS UPON THE SOLAR POWER SATELLITE MICROWAVE SYSTEM
E M KERWIN and G D ARNDT (NASA, Johnson Space Center, Houston, TX) Space Solar Power Review (ISSN 0191-9067), vol 3, no 4, 1982, p 255-280

The object of this investigation is to determine the grating lobe characteristics for the SPS (solar power satellite) microwave power beam Using techniques of Fourier array decomposition, equations, and numerical results are given for the complete SPS microwave antenna pattern (main beam plus grating lobes) In order to ensure the grating lobe peaks are below the environmental guideline of 0 01 mW/sq cm, constraints are defined for the mechanical alignment (tilt) of the SPS antenna and the satellite attitude control system Two conditions, phase control to the subarray level and to the power module (tube) level, are analyzed as to their effects upon grating lobes Author

A83-29048* National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex
ANTENNA OPTIMIZATION OF SINGLE BEAM MICROWAVE SYSTEMS FOR THE SOLAR POWER SATELLITE
E M KERWIN, D J JEZEWSKI, and G D ARNDT (NASA, Johnson Space Center, Houston, TX) Space Solar Power Review (ISSN 0191-9067), vol 3, no 4, 1982, p 281-299 refs

A generalized antenna design technique is applied to the unique environmental requirements pertaining to solar power satellite (SPS) systems Optimal illumination tapers and antenna/rectenna sizings are generated which allow increased transmit powers and lower electricity costs while minimizing sidelobe levels to meet a 0 01 mW/sq cm environmental standard These optimal tapers also provide other advantages over the 10 dB Gaussian reference system Author

A83-29049* National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex

MULTIPLE BEAM MICROWAVE SYSTEMS FOR THE SOLAR POWER SATELLITE

G D ARNDT and E M KERWIN (NASA, Johnson Space Center, Houston, TX) Space Solar Power Review (ISSN 0191-9067), vol 3, no 4, 1982, p 301-315 refs

An antenna optimization technique is applied to the environmental requirements pertaining to SPS (solar power satellite) systems to create high efficiency, multiple beams from a single antenna Effects of rectenna spacings, subarray sizing, multiple beam degradations, antenna electrical and mechanical errors, and satellite motion are investigated Advantages of multiple beam SPS systems include operational flexibility, lower power per rectenna, fewer satellites, smaller rectennas, and adherence to a 0 01 mW/sq cm environmental guidelines for sidelobe levels These advantages suggest multiple beam systems are attractive alternatives to the present single beam system Author

A83-29803*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

REDUCTION OF RMS-ERROR IN SHALLOW FACETED LARGE SPACE ANTENNAS

W B FICHTER (NASA, Langley Research Center, Structures and Dynamics Div , Hampton, VA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 714-721

(AIAA 83-1021)

This paper examines the potential for reducing root-mean-square surface error in shallow faceted reflectors by replacing flat facets with membrane facets Exact solutions are obtained for the small lateral deflections of equilateral triangular and rectangular membranes subject to isotropic tension and parabolic edge deflections These solutions are used to minimize the rms-error between a facet of a shallow paraboloidal surface and its approximating membrane facet The resulting optimum placements and edge curvatures yield membrane facets which have significantly lower rms-errors than the corresponding best-fit flat facets The rms-error reductions are about 55 percent for equilateral triangles and 25 percent to 93 percent for rectangles, depending on aspect ratio The results suggest that the use of membrane facets conforming to curved structural members could yield reflectors with lower rms-error, or comparable error with larger facets and, hence, fewer structural members Author

N83-10502*# TRW, Inc , Redondo Beach, Calif

DEEP DISCHARGE RECONDITIONING AND SHORTED STORAGE OF BATTERIES Final Report

P F RITTERMAN May 1982 72 p refs

(Contract NAS3-21253)

(NASA-CR-167953, NAS 1 26 167953) Avail NTIS HC A04/MF A01 CSCL 10C

The identification and measurement of hydrogen recombination in sealed nickel-cadium cells makes deep reconditioning on a battery basis safe and feasible Deep reconditioning improves performance and increases life of nickel-cadium batteries in geosynchronous orbit applications The hydrogen mechanism and supporting data are presented Parameter cell design experiments are described which led to the definition of nickel-cadium cells capable of high rate overdischarge without detriment to specific energy Nickel-cadium calls of identical optimum design were successfully cycled for 7 seasons in simulation of geosynchronous orbit at 75 percent depth-of-discharge with extensive midseason and end-of-season overdischarge at rates varying from C/20 to C/4 Destrucive physical analysis and cyclin data indicated no deterioration or the development of dangerous pressures as a result of the cycling with overdischarge Author

N83-12130# Air Force Geophysics Lab , Hanscom AFB, Mass Space Physics Div

HIGH-LEVEL SPACECRAFT CHARGING ENVIRONMENTS NEAR GEOSYNCHRONOUS ORBIT Interim Scientific Report

E G MULLEN and M S GUSSENHOVEN (Boston College) 11 Feb 1982 49 p refs

(Contract AF PROJ 7661)

(AD-A118791, AFGL-TR-82-0063, AFGL-ERP-771) Avail NTIS HC A03/MF A01 CSCL 22B

High-level spacecraft charging events in sunlight are discussed and statistically analyzed to determine environmental parameters critical to charging and the region of space near geosynchronous altitude where charging occurs Significant levels of spacecraft charging are shown to occur only between 1900 LT and 0900 LT at any altitude or latitude of the SCATHA satellite orbit High-level charging is shown to occur only during periods when the magnetic activity index is 2+ or greater Distribution functions of energetic electrons and ions are presented for 3 high-level charging periods on days 114, 241 and 363, 1979 Moments of the distribution functions are determined, and fitting techniques used to derive two-Maxwellian densities and temperatures are discussed Results are provided in a format usable in satellite design specifications GRA

N83-12304*# Old Dominion Univ , Norfolk, Va Dept of Electrical Engineering Technology

DEVELOPMENT OF COMPUTER MODELS FOR THE PREDICTION OF LARGE DISTORTED ANTENNA CHARACTERISTICS Final Report, period ending 15 Jul. 1982

S M MOSKOWITZ Oct 1982 114 p

(Contract NAG1-63)

(NASA-CR-169479, NAS 1 26 169479) Avail NTIS HC A06/MF A01 CSCL 20N

A program for calculating the radiation patterns of analytic reflector antennas, using geometric optics and aperture plane integration techniques, was modified and extended to include nonanalytic surfaces The original program, while capable of predicting patterns for a variety of reflectors, both smooth and multipanelled, was subject to the restriction that the surface had to be expressed analytically, i e , described by a set of mathematical equations This restriction was removed by adapting a technique which allows the reflector configuration to be interpolated from a finite set of points measured on the surface Criteria for choosing both the number and distribution of these measured surface points were developed by comparing the predicted antenna radiation patterns with measured laboratory results Test cases involved relatively smooth as well as grossly distorted arbitrary surfaces Finally, surface point accuracies were established by applying random error analysis to the measurement process S L

N83-13154*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

ADVANCED 30/20 GHZ MULTIPLE-BEAM ANTENNAS FOR COMMUNICATIONS SATELLITES

R W MYHRE 1982 21 p refs Presented at the Symp on Antenna Applications, Monticello, Ill , 22-24 Sep 1982, sponsored by AFSC and Illinois Univ

(NASA-TM-82952, E-1365, NAS 1 15 82952) Avail NTIS HC A02/MF A01 CSCL 22B

Design concepts under development utilize two separate spacecraft antenna systems, one uplink at 30 GHz and the other a downlink at 20 GHz, where each antenna provides multiple fixed and scanning beams Two contractors completed configuration trade-off studies and breadboarding of critical technology components, and are fabricating and testing proof-of-concept (POC) models to demonstrate the technology feasibility Technology developments required for the proposed systems are presented, along with each contractor's progress to date The technology development areas discussed include (1) offset Cassegrain and shaped reflector systems for narrow beams with low sidelobes and wideangle off-axis scan, (2) diplexed beam-forming networks for dual polarization, low sidelobes, and fixed and scan-beam operation, (3) fast switching networks for scanning beams, and (4) fabrication of precision feed components and large offset reflectors A R H

N83-14365*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
ENVIRONMENTALLY INDUCED DISCHARGES ON SATELLITES
N J STEVENS *In* ESA 2nd ESTEC Spacecraft Electromag Compatibility Seminar p 161-172 Jul 1982 refs
Avail NTIS HC A10/MF A01
A discharge process whose trigger conditions are a negative exposed metallic surface surrounded by a less negative dielectric, and a large voltage gradient at a dielectric/metal interface is proposed Analysis of SCATHA data for a discharge substantiates the postulation Surface discharges cause a small transient charge transfer to space which results in voltage transients A method of computing these transients, based on the charge lost through the capacitance to space and a fraction of charge stored in the dielectric at the discharge source was developed It gives an estimate of the discharge transients at the discharge site, which is used as input for coupling code analysis of structure/system response The transient computations were applied to a three-axis stabilized, geosynchronous satellite for both sunlight and eclipse charging The energy of the transient pulses are about 1 mJ for sunlight discharge and 8 mJ for eclipse Changing of selected coatings on the satellite would relieve the stress Author (ESA)

N83-14366# Giessen Univ (West Germany) Inst of Physics
THE POSSIBILITY OF CONTROLLING SPACECRAFT CHARGING BY MEANS OF THE ELECTRIC PROPULSION SYSTEM RIT 10
N K WIKOLAIZIG, K W BESCHERER, K H GROH, and H W LOEB *In* ESA 2nd ESTEC Spacecraft Electromag Compatibility Seminar p 173-178 Jul 1982 refs
(Contract ESTEC-3639/78/NL-AK)
Avail NTIS HC A10/MF A01
The use of RIT 10 for the active control of arc discharges was studied The influence of operating RIT 10 and/or its neutralizer on the surface potential of samples exposed to electron irradiation was assessed The neutralizer reduces surface potential from initial values of thousands of volts to a few hundred Results are improved by the addition of the RIT motor Author (ESA)

N83-14671*# Westinghouse Electric Corp, Pittsburgh, Pa Advanced Energy Systems Div
LOW COST SOLAR ARRAY PROJECT CELL AND MODULE FORMATION RESEARCH AREA: PROCESS RESEARCH OF NON-CZ SILICON MATERIAL Quarterly Report, 1 Jun. - 31 Aug. 1982
1981 33 p
(Contract JPL-955909)
(NASA-CR-169632, NAS 1 26 169632, DOE/JPL-955909-82-7, TME-3158, DRL-157, DRD-SE-2, QR-7) Avail NTIS HC A03/MF A01 CSCL 10A
Liquid diffusion masks and liquid applied dopants to replace the CVD Silox masking and gaseous diffusion operations specified for forming junctions in the Westinghouse baseline process sequence for producing solar cells from dendritic web silicon were investigated The baseline diffusion masking and drive processes were compared with those involving direct liquid applications to the dendritic web silicon strips Attempts were made to control the number of variables by subjecting dendritic web strips cut from a single web crystal to both types of operations Data generated reinforced earlier conclusions that efficiency levels at least as high as those achieved with the baseline back junction formation process can be achieved using liquid diffusion masks and liquid dopants The deliveries of dendritic web sheet material and solar cells pecified by the current contract were made as scheduled Author

N83-14695*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
THE SWING TO CONCENTRATOR ARRAYS
J L MILLER *In* ESA Photovoltaic Generators in Space p xix-xxiv Jun 1982 refs
Avail NTIS HC A15/MF A01 CSCL 10A
Objectives and progress in both low concentration ratio (6 to 10) and high concentration ratio (100) array developments are summarized Problems encountered include thermal control, maldistribution of concentrated sunlight, current busing, and optical surface degradation The potential advantages over planar arrays are an order of magnitude reduction in per unit cost of power plus increased immunity to radiation damage Author (ESA)

N83-14696# AEG-Telefunken, Wedel (West Germany)
LOW EARTH ORBIT BLANKET TECHNOLOGIES FOR THE POWER RANGE OF 15-60 KW
H BEBERMEIER *In* ESA Photovoltaic Generators in Space p 3-7 Jun 1982 refs
Avail NTIS HC A15/MF A01
The development of a 3 2 x 50 m foldable solar array is discussed The blanket skin has a homogeneous rear side wiring of copper A very thin foil is bonded onto the rear side of the glass fiber reinforced Kapton, giving extremely high in-plane and out-of-plane stiffness of the array compared to present technology Metallic foil is also used to reinforce the hinge cusp and foldline cusp The bending stiffness over the width of the array is optimized by the height and shape of the cusp and its reinforcement Silicon or embossed Kapton damping cross elements (padding) placed in the solar cell corner gap, come down onto the center of the adjacent cell during retraction A 5 x 5 cm silicon cell with back surface is used Author (ESA)

N83-14697# Royal Netherlands Aircraft Factories Fokker, Amsterdam
ADVANCED RIGID ARRAY
D MAWIRA *In* ESA Photovoltaic Generators in Space p 9-14 Jun 1982 refs
Avail NTIS HC A15/MF A01
The development of an advanced rigid solar array designed to provide powers from 2 to 6 kW for medium class communications satellites is described For satellites with single axis Sun tracking solar arrays, a rigid structure is suitable A 50/50 percentage weight proportion, using back surface reflector/back surface field 100 microns solar cells, is possible No interference problems are expected for the electrical system design Author (ESA)

N83-14698# AEG-Telefunken, Wedel (West Germany) Neue Technologien
MODULE TECHNIQUE OF 5 X 5 CM(2) SOLAR CELLS
J KOCH *In* ESA Photovoltaic Generators in Space p 17-21 Jun 1982 refs Sponsored by Bundesministerium fuer Forschung und Technologie
Avail NTIS HC A15/MF A01
Investigations of cover glass bonding, contact welding, interconnection design and solar cell laydown to substrates are summarized The module technique for 5 x 5 cm cells is characterized by 100 micron thick space qualified cover glasses (microsheet and fused silica) and interconnectors with stress reliefs in an out of plane and an inplane configuration Thermal cycle tests prove the applicability of 5 x 5 cm cell module techniques on solar arrays Author (ESA)

N83-14699*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
LARGE AREA LOW-COST SPACE SOLAR CELL DEVELOPMENT
C R BARONA and J L CIONI (NASA Johnson Space Center) *In* ESA Photovoltaic Generators in Space p 23-26 Jun 1982 refs
Avail NTIS HC A15/MF A01 CSCL 10A
A development program to produce 5 9 x 5 9 cm space quality silicon solar cells with a cost goal of 30 $/W is described Cell

types investigated include wraparound dielectric, mechanical wraparound and conventional contact configurations with combinations of 2 or 10 ohm/cm resistivity, back surface reflectors and/or fields, and diffused or ion implanted junctions A single step process to cut cell and cover glass simultaneously is being developed Results for cell and array tests are given Large solar arrays that might use cells of this type are discussed
Author (ESA)

N83-14713*# National Aeronautics and Space Administration, Washington, D C
NASA SPACE PHOTOVOLTAIC RESEARCH AND TECHNOLOGY PROGRAMS
J P MULLIN and D J FLOOD *In* ESA Photovoltaic Generators in Space p 121-126 Jun 1982
Avail NTIS HC A15/MF A01
The NASA programs for increasing conversion efficiency, reduced mass and cost, and extending operating life of photovoltaic converters and arrays and for evaluating advanced solar array concepts are outlined Research into radiation resistance and annealing, development of thin blankets, high-power low-cost arrays, and lightweight structures for near-Earth and planetary applications are discussed Author (ESA)

N83-14714# Societe Nationale Industrielle Aerospatiale, Cannes (France)
TV-SAT SOLAR ARRAY
G URBAIN, C RINN, and J L BASTARD *In* ESA Photovoltaic Generators in Space p 129-133 Jun 1982 refs
Avail NTIS HC A15/MF A01
The electrical and mechanical performance of the TV-SAT direct television broadcasting satellite is described The 4 5 kW end of life 7 5yr array contains 43,200 back surface reflector solar cells The first, 3 1 kW, array consists of two identical wings, providing power during transfer and geostationary orbit Each wing is made up of four carbon fiber panels The outboard panel of each wing is deployed at 90 deg in transfer orbit, during which the satellite is three axis stabilized Author (ESA)

N83-14715# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost Space Div
FURTHER DEVELOPMENTS OF THE ECS SOLAR ARRAY
A VIELEERS and F ZIJDEMANS *In* ESA Photovoltaic Generators in Space p 135-140 Jun 1982 refs
Avail NTIS HC A15/MF A01
The ECS/MARECS communications satellite modular solar array is described The baseline array configuration provides 1000 W at 50 V for a minimum lifetime of 1 yr for ECS The array consists of two wing assemblies, each having three identical panels hinged together and connected to the spacecraft via a yoke The lightweight panel substrates are of the rigid sandwich concept, 2240 solar cells are bonded onto each of the rectangular panels The electrical baseline design configurations matches requirements of a regulated bus No special battery charge sections are allocated The power generating element is a 10 ohm-cm shallow diffused 20 95 x 40 35 mm high efficiency solar cell of 180 micron nominal thickness Power-weight ratio is 26W/kg Communication and scientific satellite applications are described Author (ESA)

N83-14721# Physikalisch-Technische Studien G m b H , Freiburg (West Germany)
LOSS CURRENTS OF SOLAR CELLS UNDER LOW EARTH ORBIT (LEO) CONDITIONS
G STASEK *In* ESA Photovoltaic Generators in Space p 173-177 Jun 1982 refs
Avail NTIS HC A15/MF A01
Loss currents through plasma for different solar cell samples were measured as a function of the potential difference, distance and angle against the plasma stream, in a plasma chamber Loss currents of 2 micro A at 200 V for a solar panel, and a lower limit for typical discharge voltages of about 200 to 300 V for solar cells are reported Dependencies of these quantities and test results show that current and discharge voltage are governed principally by the available charged particle densities, especially electrons, and the active sample surface The area of these surfaces determines the current in the ohmic region whereas their geometry (edges, tips) governs the discharge voltage In the discharge region secondary electron production increases the current
Author (ESA)

N83-14726# Pilkington Bros Ltd , Ormskirk (England)
CMX-50: A NEW ULTRA THIN SOLAR CELL COVER FOR LIGHTWEIGHT ARRAYS
H TAYLOR, A F SIMPSON, and A A DOLLERY (RAE, Farnborough, England) *In* ESA Photovoltaic Generators in Space p 211-214 Jun 1982 refs
Avail NTIS HC A15/MF A01
Developments which extend the available thickness range of cerium glass solar cell covers down to 0 050 mm are described A continuous draw process offers a high volume, low cost solar cell cover material to integrate with thin silicon solar cells for the assembly of large area lightweight solar arrays The cell covers are manufactured from an improved glass composition incorporating cerium dioxide This glass (CMX) maintains UV cut-off and transmission properties to match the spectral response characteristics of current silicon solar cell types, provides the necessary UV rejection and ionizing particle radiation resistance, and has a high emittance value Author (ESA)

N83-14729# TRW Space Technology Labs , Redondo Beach, Calif
ULTRALIGHTWEIGHT SOLAR ARRAY TECHNOLOGY
P GOLDSMITH and R KURLAND *In* ESA Photovoltaic Generators in Space p 231-240 Jun 1982
Avail NTIS HC A15/MF A01
Flat fold array technology is described, and performance for a range of missions and power levels is predicted The array employs large area flat panel flexible substrates The solar cells are adhesively bonded to a thin Kapton substrate to form individual panel assemblies Any number of these panel assemblies may be joined together to make a blanket assembly A container assembly protects each blanket assembly when stowed, and a tension guide wire assembly controls the flexible blanket shape when fully extended Blanket extension and retraction are achieved through a motor powered lightweight trilongeron coilable lattice mast assembly Ground and zero gravity flight tests on prototype array assemblies are successful Author (ESA)

N83-14733# Societe Nationale Industrielle Aerospatiale, Cannes (France)
ARABSAT SOLAR ARRAY
R LAGET, C LONG, and P GUYOT *In* ESA Photovoltaic Generators in Space p 271-275 Jun 1982 refs
Avail NTIS HC A15/MF A01
The electrical and mechanical performances of the ARABSAT medium class satellite solar array are described Primary power (1 3 kW end of 7 yr life) is provided by two separate Sun-oriented solar array wings equipped with back surface reflector The solar generator is directly derived from graphite epoxy wing technology It is suitable for telecommunication satellites owing to its very good power/mass ratio (21 4 W/kg), the three axis stabilization and the partial deployment of the solar array during transfer orbit
Author (ESA)

N83-14735# British Aerospace Dynamics Group, Bristol (England)
SOLDERED SOLAR ARRAYS
H C ALLEN *In* ESA Photovoltaic Generators in Space p 287-289 Jun 1982
Avail NTIS HC A15/MF A01
The ability of soldered interconnects to withstand a combination of long life and severe environmental conditions was investigated Improvements in joint life from the use of solder mixes appropriate to low temperature conditons were studied Solder samples were placed in a 150 C oven for 5 weeks (= 12 yr at 80 C, or 24 at 70 C according to Arrhenius's rule) Conventional and high solder

melting point array samples underwent 1000 thermal cycles between -186 and 100 C Results show that conventional and lead rich soldered arrays can survive 10 yr geostationary orbit missions Author (ESA)

N83-14736# British Aerospace Dynamics Group, Bristol (England) Space and Communications Div

PROGRESS AND DEVELOPMENT STATUS OF THE SPACE TELESCOPE SOLAR ARRAY

R H W FOX *In* ESA Photovoltaic Generators in Space p 263-298 Jun 1982 refs

Avail NTIS HC A15/MF A01

The development status of the Space Telescope solar array flexible solar cell blanket deployment mechanism, primary deployment mechanism and array orientation subsystems are reviewed The array has a life time requirement of 5 yr Design features include the ability to be operated manually in space and replaced as a complete unit in-orbit Since the Space Telescope itself is too large to test in a conventional, satellite manner, thermal and dynamic analyses were used to prove the design The deployed array inertia of 700 kg/sqm per wing and the extreme pointing accuracy requirement of the Space Telescope require an extremely sophisticated array orientation subsystem Author (ESA)

N83-14737# British Aerospace Dynamics Group, Bristol (England) Space and Communications Div

FUTURE DEVELOPMENTS AND APPLICATIONS FOR THE SPACE TELESCOPE SOLAR ARRAY

R H W FOX *In* ESA Photovoltaic Generators in Space p 299-303 Jun 1982

Avail NTIS HC A15/MF A01

The adaptation of the Space Telescope solar array to experimental platforms or space shuttle limited duration missions is considered Using the present design technology, a power growth up to 10 kW is envisaged Geostationary orbit power versus mass for variants up to 8kW (10 year equinox) are shown Power can be increased by adding solar panel assemblies (SPA) to the blankets The present 8 in drum diameter and flexible power transfer harness enables a further SPA to be added by extending the Bi-Stem booms an additional 1 2 m, giving 6 kW beginning of life (BOL) By deletion when not required of shadow diodes (+4%) and the use of higher efficiency cells (+5%) a further power growth to 6 7kW BOL is possible with negligible impact on the present design, and qualification status For increases of SPA above 6 per half wing, 24 total, the Bi-Stem size must be increased, Alternatively, Bi-Stem type and drum diameter increase may be possible Both modifications are straightforward but require partial requalification Author (ESA)

N83-15560# Rome Air Development Center, Griffiss AFB, N Y

ERROR SOURCES IN MEASUREMENTS OF LARGE-APERTURE SPACE-BASED RADAR ANTENNAS

R L HAUPT and M J OBRIEN May 1982 23 p

(Contract AF PROJ 4600)

(AD-A119922, RADC-TR-82-118) Avail NTIS HC A02/MF A01 CSCL 17I

The sources of errors associated with measuring the radiation pattern of space-deployable radar antenna are examined The specifications for the Space-Based Radar require a lightweight, fragile antenna with a large aperture and low sidelobes These three requirements place severe constraints on both the testing environment and the measurement equipment Applicable sources of errors were presented for both farfield and nearfield measurement techniques Author (GRA)

N83-15808*# Pennsylvania Univ, Philadelphia

NEW SILICON CELL DESIGN CONCEPTS FOR 20 PERCENT AMI EFFICIENCY

M WOLF *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 5-12 1982 refs

Avail NTIS HC A12/MF A01 CSCL 10A

The basic design principles for obtaining high efficiency in silicon solar cells are reviewed They critically involve very long minority carrier lifetimes, not so much to attain high collection efficiency, but primarily for increased output voltages Minority carrier lifetime, however, is sensitive to radiation damage, and particularly in low resistivity silicon, on which the high efficiency design is based Radiation resistant space cells will therefore have to follow differing design principles than high efficiency terrestrial cells Author

N83-15810*# Spire Corp, Bedford, Mass

LARGE AREA SPACE SOLAR CELL ASSEMBLIES

M B SPITZER and M J NOWLAN *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 25-36 1982 refs

Avail NTIS HC A12/MF A01 CSCL 10A

Development of a large area space solar cell assembly is presented The assembly consists of an ion implanted silicon cell and glass cover The important attributes of fabrication are (1) use of a back surface field which is compatible with a back surface reflector, and (2) integration of coverglass application and call fabrication Author

N83-15829*# Air Force Wright Aeronautical Labs, Wright-Patterson AFB, Ohio

PROGRESS IN DEVELOPING HIGH PERFORMANCE SOLAR BLANKETS AND ARRAYS

J SCOTT-MONCK *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 201-209 1982 refs

Avail NTIS HC A12/MF A01 CSCL 10A

The development of high efficiency, ultrathin silicon solar cells offers both opportunity and challenge It is possible to consider 400 W/kg blanket designs by using this cell in conjuction with flexible substrates, ultrathin covers and welded interconnects By designing array structure which is mechanically and dynamically compatible with very low mass blankets, solar arrays with a specific power approaching 200 W/kg are achievable Further improvements in blanket performance (higher power and lower mass per unit area), which could come from the implementation of higher efficiency cells operating at lower temperatures (silicon or GaAs), and the use of encapsulants, would result in the development of 300 W/kg solar arrays L F M

N83-15830*# TRW Defense and Space Systems Group, Redondo Beach, Calif

MINIATURIZED CASSEGRAINIAN CONCENTRATOR CONCEPT DEMONSTRATION

R E PATTERSON and H S RAUSCHENBACH *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 211-221 1982 refs

(Contract NAS8-34131)

Avail NTIS HC A12/MF A01 CSCL 10A

High concentration ratio photovoltaic systems for space applications have generally been considered impractical because of perceived difficulties in controlling solar cell temperatures to reasonably low values A miniaturized concentrator system is now under development which surmounts this objection by providing acceptable solar cell temperatures using purely passive cell cooling methods An array of identical miniaturized, rigid Cassegrainian optical systems having a low f-number with resulting short dimensions along their optical axes are rigidly mounted into a frame to form a relatively thin concentrator solar array panel A number of such panels, approximately 1 5 centimeters thick, are wired as an array and are folded against one another for launch in a stowed configuration Deployment on orbit is similar to the deployment of conventional planar honeycomb panel arrays or flexible blanket arrays The miniaturized concept was conceived and studied in the 1978-80 time frame Progress in the feasibility demonstration to date is reported L F M

N83-15831*# Jet Propulsion Lab, California Inst of Tech, Pasadena
THE COURSE OF SOLAR ARRAY WELDING TECHNOLOGY DEVELOPMENT
P M STELLA *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 223-230 1982 refs
Avail NTIS HC A12/MF A01 CSCL 10A

Solar array welding technology is examined from its beginnings in the late 1960's to the present The U S and European efforts are compared, and significant similarities are highlighted The utilization of welding technology for space use is shown to have been influenced by a number of subtle, secondary factors Author

N83-15838*# Jet Propulsion Lab, California Inst of Tech, Pasadena
BLANKET TECHNOLOGY
J SCOTT-MONCK *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 269-272 1982
Avail NTIS HC A12/MF A01 CSCL 10A

It was concluded that systems requirements would force a reassessment of the conventional approach to interconnecting cells into blanket or array modules Defense applications (hardening) were identified as the key requirement that would force a movement away from the standard method (solder) of forming array circuits The panel also agreed that requirements associated with the impending NASA Space Station and in-bound missions would lead to alternative interconnecting approaches It was concluded that the diverse requirements of future space missions (high temperature and extended thermal cycling) might not be met by one approach, such as parallel-gap resistance welding The panel suggested that other options such as high temperature solders and brazing be considered for the various mission requirements that were anticipated The panel agreed that blanket technology was potentially suitable for in-orbit annealing to temperatures of 200 C provided that conventional soldered connecting techniques were replaced by 'welding' L F M

N83-15855# Los Alamos Scientific Lab, N Mex
OVERVIEW OF SPACE REACTORS
D BUDEN *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 1 44 p 1982
Avail NTIS HC A99/MF A01 CSCL 10B

An overview of spacecraft power supplies needed in the future is presented in outline form Subjects portrayed and discussed are potential space power missions, space power technology capabilities, conversion technology, radiator technology, and reactor safety L F M

N83-15858# Westinghouse Electric Corp, Pittsburgh, Pa Advanced Energy Systems Div
GAS COOLED REACTORS FOR LARGE SPACE POWER NEEDS
G H PARKER *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 1 21 p 1982
Avail NTIS HC A99/MF A01 CSCL 10B

Gas cooled space reactors can be built in the next few years and their performance capabilities exceed those of the power conversion systems (PCS) that the reactors will drive For space applications requiring MW(e), the closed cycle Brayton cycle is a strong candidate for the PCS For these high power levels, waste heat rejection to space by radiators tends to drive systems to high operating temperatures so that reasonably sized system envelope dimensions can be attained Thus, compact, high power density, high temperature, high burnup reactors will be needed The technology base for these reactors is well established Author

N83-15863# Argonne National Lab, Ill
PRIME POWER FOR HIGH-ENERGY SPACE SYSTEMS: CERTAIN RESEARCH ISSUES Final Report
E W WALBRIDGE *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 10 p 1982 refs
Avail NTIS HC A99/MF A01

The physical mechanisms underlying Alfven wave drag and induced magnetic moment effects on high energy space systems are described An expression for the induced magnetic moment of a (ring-shaped) satellite is presented Several other issues requiring attention are also pointed out These include, in particular, the need to avoid a demise like that of Skylab, how to obtain high heat engine thermal efficiency, what to do about the damaging effects of Van Allen belt radiation, and the need for storing energy over long periods but having it quickly available on short notice M G

N83-15865*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
DIRECT CONVERSION OF INFRARED RADIANT ENERGY FOR SPACE POWER APPLICATIONS Final Report
R C FINKE *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 22 p 1982
Avail NTIS HC A99/MF A01

A proposed technology to convert the earth radiant energy (infrared albedo) for spacecraft power is presented The resultant system would eliminate energy storage requirements and simplify the spacecraft design The design and performance of a infrared rectenna is discussed M G

N83-15868*# Rice Univ, Houston, Tex Dept of Space Physics and Astronomy
INTERACTION BETWEEN THE SPS SOLAR POWER SATELLITE SOLAR ARRAY AND THE MAGNETOSPHERIC PLASMA Final Report
J W FREEMAN *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 18 p 1982 refs
(Contract NAS8-33023)
Avail NTIS HC A99/MF A01

The results of study to determine the effects of space plasmas on a large GaAs solar cell array using solar reflectors at a concentration ratio of two in geostationary orbit are summarized It was concluded that the system could function in the GEO environment if certain design changes were implemented These included conductive coatings on the solar cells, changing the reflector material from Kapton to a higher conductivity material, and oversizing the array to compensate for a 0 7% parasitic load due to losses from the ambient magnetospheric plasma The operation of the solar powered earth orbit transfer vehicle (EOTV) was also examined and it was concluded that LEO servere arcing would take place on all high voltage negative portions of the array The parasitic load loss at LEO was estimated at 3% Operation of a high voltage array at LEO represents a major problem Charge exchange ion feedback from argon ion thrusters located near the EOTV solar array was also examined and all problems found were believed to be solvable by the placement of protective ground screens M G

N83-15887# Thermo Electron Corp, Waltham, Mass
THERMIONIC TECHNOLOGY FOR SPACECRAFT POWER PROGRESS AND PROBLEMS Final Report
F HUFFMAN, D LIEB, P REAGAN, and G MISKOLCZY *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 30 p 1982 refs
Avail NTIS HC A99/MF A01

Thermionic conversion for use with space reactors is discussed Advantages are discussed, as well as development problems The mechanical simplicity associated with no moving parts implies reliability The high temperature of heat rejection minimizes the mass of the radiator - which is usually the heaviest component of large space power systems The high heat rejection temperature also limits the size of the radiator, which is an important consideration, since all space reactor systems in the foreseeable future must fit inside the space shuttle bay Modularity maximizes reliability by eliminating single point system failures In addition, thermionics is a demonstrated conversion technology coupled to nuclear reactors Although available thermionic converter performance yields systems with attractive specific masses of around 20 kG/kWe, higher efficiency and power density are certainly desirable For space systems, this improvement must accrue from reduced potential losses in the interelectrode plasma since the radiator temperature will be too high to take advantage of collector work functions lower than those already available
R J F

N83-15898# Layton (J Preston), Princeton Junction, N J
POWER CONVERSION: OVERVIEW Final Report
J P LAYTON *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 23 p 1982 refs
Avail NTIS HC A99/MF A01

The central position of power conversion systems in relation to other elements of space power systems is identified and the recognized types of power conversion are shown to be photovoltaic, thermoelectric, Brayton cycle, Rankine cycle, Stirling cycle, thermionic and electromagnetic The requirement for space electric power levels versus calendar years are presented historically and projected beyond the turn of the century A number of space power systems that may employ thermoelectric, Brayton, Rankine and magnetohydrodynamic power conversion are illustrated and discussed The need for mission and systems analyses to support the identification of applied research in power conversion is argued and the approach for conducting these analyses is presented
Author

N83-16630*# General Electric Co, Philadelphia, Pa Space Div
DESIGN STUDY OF A HIGH POWER ROTARY TRANSFORMER
S M WEINBERGER Jul 1982 59 p refs
(Contract NAS3-23155)
(NASA-CR-168012, NAS 1 26 168012, GE-82SDS4222) Avail NTIS HC A04/MF A01 CSCL 09C

A design study was made on a rotary transformer for transferring electrical power across a rotating spacecraft interface The analysis was performed for a 100 KW, 20 KHz unit having a "pancake" geometry The rotary transformer had a radial (vertical) gap and consisted of 4-25 KW modules It was assumed that the power conditioning comprised of a Schwarz resonant circuit with a 20 KHz switching frequency The rotary transformer, mechanical and structural design, heat rejection system and drive mechanism which provide a complete power transfer device were examined The rotary transformer losses, efficiency, weight and size were compared with an axial (axial symmetric) gap transformer having the same performance requirements and input characteristics which was designed as part of a previous program The "pancake" geometry results in a heavier rotary transformer primarily because of inefficient use of the core material It is shown that the radial gap rotary transformer is a feasible approach for the transfer of electrical power across a rotating interface and can be implemented using presently available technology
Author

N83-18023*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md
COMPARATIVE VALUES OF ADVANCED SPACE SOLAR CELLS
L W SLIFER, JR Sep 1982 21 p refs Presented at the 16th IEEE Photovoltaic Spec Conf, San Diego, Calif, 27-30 Sep 1982
(NASA-TM-84951, REPT-711, NAS 1 15 84951) Avail NTIS HC A02/MF A01 CSCL 10A

A methodology for deriving a first order dollar value estimate for advanced solar cells which consists of defining scenarios for solar array production and launch to orbit and the associated costs for typical spacecraft, determining that portion affected by cell design and performance and determining the attributable cost differences is presented Break even values are calculated for a variety of cells, confirming that efficiency and related effects of radiation resistance and temperature coefficient are major factors, array tare mass, packaging and packing factor are important, but cell mass is of lesser significance Associated dollar values provide a means of comparison
Author

N83-18811# British Aerospace Dynamics Group, Stevenage (England)
SPACECRAFT CHARGING· HOW TO MAKE A LARGE COMMUNICATIONS SATELLITE IMMUNE TO ARCING
C N FELLAS *In* ESA Spacecraft Mater in a Space Environ p 305-309 Jul 1982 refs
Avail NTIS HC A15/MF A01

External dielectric surface used as thermal control materials on spacecraft are likely to charge to several thousand volts when exposed to the electron environment of the geosynchronous orbit Consequent discharges pose a potential hazard to the spacecraft Three design philosophies exist for remedying the problem The electronic circuits may be protected by filtering techniques Shielding techniques exist to reduce the propagation of electrostatic discharge pulses through the structure and cable harness Finally the thermal control materials may be selected or designed to minimize charging and in certain cases to eliminate potentially dangerous discharges This paper concentrates on the control of spacecraft charging by suitable thermal control materials Specific solutions are described for the three most critical areas of a spacecraft The thermal control blankets, the optical solar Reflectors and the Solar Array
Author

N83-19529# Purdue Univ, Lafayette, Ind School of Electrical Engineering
THE ANALYSIS OF DESIGN OF ROBUST NONLINEAR ESTIMATORS AND ROBUST SIGNAL CODING SYSTEMS Final Report, 15 Jun. 1978 - 14 Jun. 1982
N C GALLAGHER, JR 16 Sep 1982 156 p refs
(Contract AF-AFOSR-3605-78, AF PROJ 2304)
(AD-A121294, AFOSR-82-0933TR) Avail NTIS HC A08/MF A01 CSCL 12A

Two topics of engineering interest have been treated in this research One is block or vector quantization, which deals with the digital representation of multi-dimensional signals Two Ph D dissertations and one patent application, in addition to numerous technical articles have resulted from this work The other area of study has been nonlinear signal estimating which has lead to a study of median filtering This work on median filtering has resulted in two Ph D dissertations in addition to a number of technical publications
Author (GRA)

N83-21010# British Aerospace Dynamics Group, Stevenage (England) Space and Communications Div
THE L-SAT POWER SUBSYSTEM
R B A HARRIS *In* ESA 4th ESTEC Spacecraft Power-Conditioning Seminar p 27-31 Sep 1982 refs
Avail NTIS HC A09/MF A01

A description of the power subsystem for the L-SAT platform is given The system design features a modular concept so that a wide range of payload power requirements for L-SAT satellites can be met from a standard set of hardware by straightforward selection The design of the power subsystem is based on that used in the ECS/MARECS range of satellites, but some new concepts are introduced These include the use of nickel hydrogen batteries, and an a c distribution system for auxiliary and low power supplies both in the platform and payload The power system is designed for high power missions, reflecting the capabilities of L-SAT, being extendible to power missions of up to 7 0 kW payload in sunlight and 2 5 kW in eclipse Author

N83-21215# TICRA ApS, Copenhagen (Denmark) Communications Systems and Antennas Div

STUDY OF SOFTWARE FOR OPTIMIZATION OF CONTOURED BEAM REFLECTOR ANTENNAS. VOLUME 1: SUMMARY REPORT

P BALLING, R JOERGENSEN, P H NIELSEN, K PONTOPPIDAN, G ANTEBORN (L M Ericsson), P INGVARSON (L M Ericsson), J LINDH (L M Ericsson), P MALMBORG (L M Ericsson), and V SOHTELL (L M Ericsson) Paris ESA Jan 1981 35 p 2 Vol

(Contract ESTEC-4188/79/NL-DG(SC))

(S-128-04, ESA-CR(P)-1669-VOL-1) Avail NTIS HC A03/MF A01

High-gain antennas with contoured beams are envisaged in future satellite systems, e g , telecommunications and direct broadcast The principal contoured-beam antenna concept considered involves the use of a large reflector system in combination with a multiple-feed array The synthesis software developed under a previous contract was updated and validated Detailed instruction for the use of the software is given Extensive comparisons were carried out for two experimental test cases involving measured primary and secondary patterns To demonstrate an alternative to the reflector antenna with a multi-element feed array in case of a fixed contoured beam, the limitations of shaped single reflectors were examined Author

N83-21216# TICRA ApS, Copenhagen (Denmark)

STUDY OF SOFTWARE FOR OPTIMIZATION OF CONTOURED BEAM REFLECTOR ANTENNAS, VOLUME 2 Final Report

P BALLING, R JOERGENSEN, P H NIELSEN, K PONTOPPIDAN, G ANTEBORN (L M Ericsson), P INGVARSON (L M Ericsson), J LINDH (L M Ericsson), P MALMBORG (L M Ericsson), and V SOHTELL (L M Ericsson) Paris ESA Jan 1981 411 p refs 2 Vol

(Contract ESTEC-4188/79/NL-DG(SC))

(S-128-02, ESA-CR(P)-1669-VOL-2) Avail NTIS HC A18/MF A01

A step-by-step synthesis procedure, a simple analytic element beam model, optimization routines, a fast analysis program, feed element modelling, an experimental test case, check of COBRA software, European Communications Satellite antenna synthesis, and reflector antenna shaping limitations are discussed Author

N83-21513# AEG-Telefunken, Wedel (West Germany) Anlagentechnik AG

TECHNOLOGY OF ELEVATED VOLTAGE SOLAR ARRAYS: KEY ITEMS TEST AND EVALUATION. PART 2: SIMULATED LEO-PLASMA TESTS Final Report

H BEBERMEIER, G EGGERS, R NUERNBERGER, W GOELZ, and G STASEK (Physik-Tech Studien GmbH, Freiburg, West Ger) Paris ESA Mar 1982 114 p refs

(Contract ESTEC-3662/78/NL-HP, ESA-4623/81/NL-PP(SC))

(ESA-CR(P)-1646) Avail NTIS HC A06/MF A01

The electrical layout of a 250 kW solar array was analyzed in TEVSA-KITE I and potential problem areas were identified In the present report (TEVSA-KITE II) research and development activities are described which have been made necessary by the desire to understand the phenomena observed in the initial tests and to make a more complete assessment of the in-orbit effects of 200 - 1000 volt solar arrays System and component requirements of the power-conditioning system were compared with current practice in order to identify areas requiring development effort It was found that for voltages up to 200/300 V, components and systems are available but are not yet space qualified The high-voltage tests of solar-array components were continued A critical threshold of 500 - 600 V was identified for vacuum orbit conditions Outgassing after launch may be a potential reason for failure The plasma tests at Freiburg showed that there was a very narrow range in which ohmic discharge occurs Outside this range, a dramatic increase in leakage current is expected The critical voltage threshold was identified at ca 250 V The study shows that current solar-array technology is adequate for low Earth orbit environment up to a voltage of about 250 V Plasma discharge will then be initiated At voltages above 500/600 V, partial discharge through the substrate will reduce the lifetime of the solar array Author (ESA)

N83-21987*# RCA Labs , Princeton, N J

ADVANCED 3-V SEMICONDUCTOR TECHNOLOGY ASSESSMENT Final Report, 20 Jul. 1981 - 19 Jul 1982

M NOWOGRODZKI Feb 1983 235 p refs 2 Vol

(Contract NAS3-22884)

(NASA-CR-168101, NAS 1 26 168101, RCA-PRRL-82-CR-18) Avail NTIS HC A11/MF A01 CSCL 20L

Components required for extensions of currently planned space communications systems are discussed for large antennas, crosslink systems, single sideband systems, Aerostat systems, and digital signal processing Systems using advanced modulation concepts and new concepts in communications satellites are included The current status and trends in materials technology are examined with emphasis on bulk growth of semi-insulating GaAs and InP, epitaxial growth, and ion implantation Microwave solid state discrete active devices, multigigabit rate GaAs digital integrated circuits, microwave integrated circuits, and the exploratory development of GaInAs devices, heterojunction devices, and quasi-ballistic devices is considered Competing technologies such as RF power generation, filter structures, and microwave circuit fabrication are discussed The fundamental limits of semiconductor devices and problems in implementation are explored A R H

N83-22255*# TRW, Inc , Redondo Beach, Calif Space and Technology Group

REQUIREMENTS FOR A MOBILE COMMUNICATIONS SATELLITE SYSTEM. PART 3: LARGE SPACE STRUCTURES MEASUREMENTS STUDY Final Report; 15 Dec. 1981 - 31 Mar. 1983

W AKLE 31 Mar 1983 114 p

(Contract NAS3-23257)

(NASA-CR-168105, NAS 1 26 168105) Avail NTIS HC A06/MF A01 CSCL 22B

This study report defines a set of tests and measurements required to characterize the performance of a Large Space System (LSS), and to scale this data to other LSS satellites Requirements from the Mobile Communication Satellite (MSAT) configurations derived in the parent study were used MSAT utilizes a large, mesh deployable antenna, and encompasses a significant range of LSS technology issues in the areas of structural/dynamics, control, and performance predictability In this study, performance requirements were developed for the antenna Special emphasis was placed on antenna surface accuracy, and pointing stability Instrumentation and measurement systems, applicable to LSS, were selected from existing or on-going technology developments Laser ranging and angulation systems, presently in breadboard status, form the backbone of the measurements Following this, a set of ground, STS, and GEO-operational were investigated A third scale (15 meter) antenna system as selected for ground characterization followed by STS flight technology development This selection ensures analytical scaling from ground-to-orbit, and size scaling Other benefits are cost and ability to perform reasonable ground tests Detail costing of the various tests and measurement systems were derived and are included in the report Author

07

ADVANCED MATERIALS

Includes matrix composites, polyimide films, thermal control coatings, bonding agents, antenna components, manufacturing techniques, and space environmental effects on materials

A83-11334
DEVELOPMENT OF ADVANCED COMPOSITE MATERIALS AND GEODETIC STRUCTURES FOR FUTURE SPACE SYSTEMS
J F GARIBOTTI (HR Textron, Inc , Irvine, CA), A J CWIERTNY, JR , and R JOHNSON, JR (McDonnell Douglas Astronautics Co , Huntington Beach, CA) (International Astronautical Federation, International Astronautical Congress on Space Mankind's Fourth Environment, 32nd, Rome, Italy, Sept 6-12, 1981) Acta Astronautica, vol 9, June-July 1982, p 473-480 refs

The results of recent work accomplished under a NASA Johnson Space Center contract to develop an advanced composite geodetic beam and beam fabrication machine for the on-orbit construction of large space structures are given in this paper Testing to determine mechanical, physical, thermal and electrical property characteristics of a near thermally inert advanced composite material for fabrication of geodetic structures is described and results are presented Development testing of full-scale segments of geodetic structures fabricated with this material is discussed, along with results of a test to demonstrate structural feasibility of the cylindrical geodetic beam's end attachment design Future tests of a long geodetic beam with conical end attachments are described These latter tests are to verify the ability of geodetic structures to withstand mechanical and thermal loading environments of space (Author)

A83-11504
ANNUAL REVIEW OF MATERIALS SCIENCE. VOLUME 12
R A HUGGINS, (ED), R H BUBE (Stanford University, Stanford, CA), and D A VERMILYEA (General Electric Co , Fairfield, CT) Palo Alto, CA, Annual Reviews, Inc , 1982 451 p

Topics in materials science are addressed The general subjects discussed include experimental and theoretical methods, preparation, processing, and structural changes, properties and phenomena, special materials, and structure Specific subjects include, ultrasonic tomography for nondestructive evaluation, recent developments in rapidly melt-quenched crystalline alloys, spray pyrolysis processing, high temperature aerospace materials prepared by powder metallurgy, metallurgy of rechargeable hydrides, status of new thin film photovoltaic technologies C D

A83-11508
HIGH TEMPERATURE AEROSPACE MATERIALS PREPARED BY POWDER METALLURGY
E R THOMPSON (United Technologies Research Center, East Hartford, CT) In Annual review of materials science Volume 12 Palo Alto, CA, Annual Reviews, Inc , 1982, p. 213-242 refs

The preparation, handling, treatment, consolidation, applications, and properties of powders suitable for high temperature aerospace materials are discussed The atomization of alloys by gas, vacuum, and centrifugal processes are briefly described, and two approaches that minimize foreign particles and porosity stabilized by inert gas are addressed, including one that emphasizes sorting and cleaning the powder and one that attempts to eliminate the contaminating source rather than to extensively treat the powder Various compaction techniques are considered, such as hot isostatic pressing, hot extrusion, sintering, spray forming, and dynamic compaction The properties of nickel-base superalloys IN-100, Astroloy, Rene 95, Merl 76, and some others are discussed along with the influence of inclusions on superalloy fatigue characteristics The properties of titanium alloys prepared from powder are also covered C D

A83-13562
POLYSULFIDE SEALANTS FOR AEROSPACE. I - THEORY AND BACKGROUND
R E MEYER (Essex Chemical Corp , Compton, CA) SAMPE Journal, vol 18, Nov -Dec 1982, p 6-10

A sealant is defined as a polymeric material which provides environmental isolation in the range from -65 to 250 F (some to 350 F) It is pointed out that synthetic binders for aerospace sealants must exhibit resistance to oils, chemicals, water, and weathering Polysulfides are best among the oil resistant elastomers, while urethanes exhibit the best alkaline chemical resistance, followed by the polysulfides In water immersion, polysulfides again are best The present investigation is mainly concerned with the uncured and cured properties of the polysulfide sealant and the manner in which those properties can be altered, taking into account also processing and operational techniques which can aid in realizing the optimum properties of the sealant G R

A83-13742* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md
CHARACTERIZATION OF THE OUTGASSING OF SPACECRAFT MATERIALS
J J SCIALDONE (NASA, Goddard Space Flight Center, Instrument Systems Branch, Greenbelt, MD) In Shuttle optical environment, Proceedings of the Meeting, Washington, DC, April 23, 24, 1981 Bellingham, WA, SPIE - The International Society for Optical Engineering, 1982, p 2-9 refs

Equations which describe material outgassing in spaceflight conditions are integrated over temperatures up to 125 C and with outgassing kinetic energies up to 40 kcal/mole The outgassing rate is noted to be formulated as an expression of sublimation and evaporation, and can be a function of the materials of the outgassing process The predicted mass loss rates for various materials are compared with mass loss rates from materials with known activation energies, e g , silicone and solar panel samples, held at different temperatures and for varying time lengths The comparisons are made for first order and more complex outgassing kinetics The technique is concluded to be useful for a quick characterization of candidate materials for spaceflight considerations when contamination is a significant factor M S K

A83-14125*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS
D R TENNEY, G F SYKES, and D E BOWLES (NASA, Langley Research Center, Hampton, VA) NATO, AGARD, Specialists Meeting on Environmental Effects on Materials for Space Applications, Toronto, Canada, Sept 22-24, 1982, Paper 25 p refs

Research efforts at NASA-Langley to characterize the durability of composite materials which are candidates for use as components on various space hardware systems are reviewed The material applications include large space structures, antennas, cables, thermal control coatings, solar reflectors, and satellite power systems Simulation facilities have been built to study radiation effects on polymer matrix composites, and the dimensional stability of the matrix composites and tension stabilized cables Numerical models are being developed for radiation effects on the mechanical, physical, and optical properties Additionally, chemical and microstructural analyses are performed to identify damage mechanisms and the limits of effectiveness of accelerating life tests It is noted that no residual strength reduction has been detected in polymer films after dosages of 5 billion rads of electron radiation M S K

A83-15181
CHARACTERIZATION OF STABILITY MECHANISMS IN ADVANCED COMPOSITES
T J DELACY (Ford Aerospace and Communications Corp, Palo Alto, CA) and C K H DHARAN (Communications Satellite Corp, Palo Alto, CA) In Review of progress in quantitative nondestructive evaluation Volume 1 - Proceedings of the Eighth U S Air Force/Defense Advanced Research Projects Agency Symposium on Quantitative Nondestructive Evaluation, Boulder, CO, August 2-7, 1981 New York, Plenum Press, 1982, p 301-306 refs

This paper describes an investigation undertaken to study stress relief in graphite-epoxy tubular elements using nondestructive techniques - fluorescent penetrant, ultrasonic C-scan, and acoustic emission analysis Correlation with microscopy of sectioned samples was done to define the mode and location of the stress relief Composite cure, postcure and thermal preconditioning cycles were evaluated to determine their effect on dimensional stability These results are presented (Author)

A83-16506*# Hughes Aircraft Co, Culver City, Calif
DEVELOPMENT OF A NEW INTEGRAL SOLAR CELL PROTECTIVE COVER
A B NASELOW, P S DUPONT (Hughes Aircraft Co, Culver City, CA), and J SCOTT-MONCK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 5 p
(Contract JPL-955439)
(AIAA PAPER 83-0076)

A unique polyimide polymer has been developed which shows promise as an encapsulant for interconnected solar cell modules Such an integral cover offers important weight and cost advantages The polymer has been characterized on silicon solar cells with respect to electrical output and spectral response The response of the material-coated cells to electron, low-energy proton, and vacuum-ultraviolet radiation, thermal shock and humidity tests was determined (Author)

A83-16805*# Jet Propulsion Lab, California Inst of Tech, Pasadena
PULSE RADIOLYSIS OF EPOXY-BASED MATRIX MATERIALS
D R COULTER, A GUPTA, F D TSAY, J MOACANIN, and R LIANG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 7 p NASA-supported research
(AIAA PAPER 83-0586)

Electron beam pulse radiolysis (600 KeV, 3 nsec) experiments have been carried out on epoxy-based matrix materials Time and wavelength resolved emission and transient absorption techniques as well as ESR studies have been utilized to identify and monitor short lived reactive intermediates resulting from energetic electron impact An energy deactivation model based on the results of this work has been developed Recombination of primary charged species is found to be fast, resulting in the formation of longer lived excited electronic states and radicals which control the subsequent energy deactivation (Author)

A83-16806#
SIMULATED SPACE ENVIRONMENTAL EFFECTS ON FIBER REINFORCED POLYMERIC COMPOSITES
J S HANSEN and R C TENNYSON (Toronto, University, Toronto, Canada) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 13 p Department of Communications of Canada Natural Sciences and Engineering Research Council of Canada refs
(Contract DCC-OSU81-00082, AF-AFOSR-78-3694A, NSERC-A-3663, NSERC-A-2783)
(AIAA PAPER 83-0589)

A continuing research program has been underway to investigate the effects of hard vacuum, thermal cycling and radiation on modulus, strength, coefficient of thermal expansion and creep compliance of selected fiber reinforced polymer matrix composite materials Data have been obtained for over 1000 thermal cycles under ambient conditions and 100 cycles under hard vacuum Further data have been obtained for exposure periods exceeding 400 days in hard vacuum and over 300 equivalent solar days of UV combined with approximately 100,000 rads of electron radiation During this time, in-situ measurements have been made of the tensile modulus, creep compliance and coefficient of thermal expansion (Author)

A83-16807*# IIT Research Inst, Chicago, Ill
MECHANISMS OF DEGRADATION OF GRAPHITE COMPOSITES IN A SIMULATED SPACE ENVIRONMENT
C GIORI, T YAMAUCHI, K RAJAN, and R MELL (IIT Research Institute, Chicago, IL) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 10 p refs
(Contract NAS1-15459)
(AIAA PAPER 83-0590)

Attention is given to degradation mechanisms for graphite/polysulfone and graphite/epoxy laminates exposed to ultraviolet and high-energy electron radiation in vacuum up to 960 equivalent sun hours and to 10 to the 9th rads, respectively The materials showed good electron radiation stability as indicated by the low G values for gas formation and no evidence of mechanical property changes Quantum yields for gas formation indicate poor stability to ultraviolet radiation Mechanical property measurements did not show significant changes up to 960 ESH, with the possible exception of P1700/C6000 The main products of irradiation were identified as hydrogen and methane, along with high levels of CO and CO2 SCS

A83-16808#
SPACE RADIATION EFFECTS ON STRUCTURAL COMPOSITES
R E MAURI and F W CROSSMAN (Lockheed Research Laboratories, Palo Alto, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan 10-13, 1983, 9 p
(AIAA PAPER 83-0591)

Advanced structural composites are being widely utilized in long-term orbiting spacecraft structures Space radiation, consisting of electrons and protons trapped in the earth's magnetic field, can alter the dimensional stability and thermomechanical properties of organic matrix or fiber composites To assess the effects of simulated space radiation, three types of graphite/epoxy and Aramid/epoxy laminated composite materials were irradiated with 1 5 MeV electrons in vacuo at a dose rate of 1 5 Mrad/h to total doses of 3 x 10 to the 9th to 1 x 10 to the 10th rad These doses correspond to the fluences delivered to the surface of a spacecraft in a geosynchronous orbit for mission durations of 30 to 50 years Test results show that graphite/epoxies incurred only minor damage effects, whereas the Aramid/epoxy was severely degraded at these dosages (Author)

A83-17498* Jet Propulsion Lab, California Inst of Tech, Pasadena
RADIATION EFFECTS ON SPACECRAFT MATERIALS FOR JUPITER AND NEAR-EARTH ORBITERS
F L BOUQUET and K F KOPROWSKI (California Institute of Technology, Jet Propulsion Laboratory, Applied Mechanics Technology Section, Pasadena, CA) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982) IEEE Transactions on Nuclear Science, vol NS-29, Dec 1982, p 1629-1632 refs
(Contract NAS7-100)

An overview of radiation effects on spacecraft materials is given in this paper Specifically, the environment of the Jupiter Orbiting Spacecraft, Galileo, is treated along with analysis methods and simulated testing Summaries of previous and present material test results are given Preliminary results of surface erosion on insulation from a Space Shuttle experiment are summarized (Author)

A83-17500* JAYCOR, San Diego, Calif
CHARGING AND DISCHARGING CHARACTERISTICS OF DIELECTRIC MATERIALS EXPOSED TO LOW- AND MID-ENERGY ELECTRONS
P COAKLEY, B KITTERER, and M TREADAWAY (JAYCOR, San Diego, CA) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982) IEEE Transactions on Nuclear Science, vol NS-29, Dec 1982, p 1639-1643 USAF-NASA-sponsored research refs

Charging and discharging characteristics of dielectric samples exposed to 1-25 keV and 25-100 keV electrons in a laboratory environment are reported The materials examined comprised OSR, Mylar, Kapton, perforated Kapton, and Alphaquartz, serving as models for materials employed on spacecraft in geosynchronous orbit The tests were performed in a vacuum chamber with electron guns whose beams were rastered over the entire surface of the planar samples The specimens were examined in low-impedance-grounded, high-impedance-grounded, and isolated configurations The worst-case and average peak discharge currents were observed to be independent of the incident electron energy, the time-dependent changes in the worst case discharge peak current were independent of the energy, and predischarge surface potentials are negligibly dependent on incident monoenergetic electrons M S K

A83-20425*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
RESEARCH IN STRUCTURES AND MATERIALS FOR FUTURE SPACE TRANSPORTATION SYSTEMS - AN OVERVIEW
H N KELLY, D R RUMMLER, and L R JACKSON (NASA, Langley Research Center, Hampton, VA) (Conference on Advanced Technology for Future Space Systems, Hampton, VA, May 8-10, 1979, Technical Papers, p 12-23) Journal of Spacecraft and Rockets, vol 20, Jan-Feb 1983, p 89-96 refs

(Previously cited in issue 14, p 2544, Accession no A79-34703)

A83-20459* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md
MODIFYING A SILICONE POTTING COMPOUND FOR SPACE FLIGHT APPLICATIONS
J J PARK and C H CLATTERBUCK (NASA, Goddard Space Flight Center, Greenbelt, MD) In National SAMPE Symposium and Exhibition, 27th, San Diego, CA, May 4-6, 1982, Proceedings Azusa, CA, Society for the Advancement of Material and Process Engineering, 1982, p 489-494

RTV-615 has been devolatilized by subjecting the uncatalyzed resin to a temperature of between 125 and 150 C for 24 hours in a vacuum of about 10 to the -6th torr The resultant resin can be catalyzed and after a room temperature cure the outgassing of the resin is sufficiently low when tested according to ASTM E-595 that it is suitable for space flight use Tests of physical properties of the cured devolatilized resin were compared with those of the as received silicone The devolatilized silicones are slightly harder, have a higher tear resistance and higher tensile strengths (Author)

A83-20465
HIGH PERFORMANCE, LOW VISCOSITY RESIN SYSTEMS
J J KING and R N CASTONGUAY (Ciba Geigy Corp, Ardsley, NY) In National SAMPE Symposium and Exhibition, 27th, San Diego, CA, May 4-6, 1982, Proceedings Azusa, CA, Society for the Advancement of Material and Process Engineering, 1982, p 551-559

The aerospace industry makes increasingly use of advanced composite structures A large amount of the advanced composite materials being used is graphite reinforced epoxy A trend towards automated manufacturing techniques is being observed in the aerospace industry The considered methods include wet filament winding and liquid injection techniques Both of these techniques require low viscosity resin systems A review is presented of low viscosity, high performance resin systems which have been developed for the considered applications Attention is given to experimental methods, hardeners, epoxy resins, accelerators and system properties G R

A83-23629
AN APPLICATION OF UNSUPPORTED FILM ADHESIVE TO FABRICATE SPACECRAFT STRUCTURES
L DOMNIKOV and R J SWITZ (Hughes Aircraft Co, Product Operations Div, El Segundo, CA) In Material and process advances '82, Proceedings of the Fourteenth National SAMPE Technical Conference, Atlanta, GA, October 12-14, 1982 Azusa, CA, Society for the Advancement of Material and Process Engineering, 1982, p 337-348

Applications are described for an unsupported film adhesive to fabricate structural parts for communication satellites Because of characteristics manufactured into the film, it will reticulate (transform from a continuous sheet to a net) when staged at proper time and temperature combinations This provides a uniform coating of adhesive to edges of the honeycomb cell walls Data from a comprehensive test program are included Results from this development test program were verified by full scale hardware environmental tests to simulate all loads Other possible applications are described, together with observations which, if found to be true, can simplify storage and handling the film prior to its use (Author)

A83-23644
GRAPHITE EPOXY SATELLITE STRUCTURE DEVELOPMENT PROGRAM
J P QUALLS (Rockwell International Corp, Seal Beach, CA) In Material and process advances '82, Proceedings of the Fourteenth National SAMPE Technical Conference, Atlanta, GA, October 12-14, 1982 Azusa, CA, Society for the Advancement of Material and Process Engineering, 1982, p 513-520

A summary is presented of the development program for the application of graphite epoxy material to the satellite primary structure of the Advanced Composites Equipment Support Module, a satellite similar to the NAVSTAR GPS but with a primary structure built of 80% graphite/epoxy The development program consisted of detail designs, material properties tests, design development testing, and the verification testing of a full-scale satellite structure built of graphite/epoxy Utilized in the structure design were several composite materials, including T300, PAN50, and P75S graphite fibers combined with the Fiberite 934 epoxy system The results of the development program demonstrate that the level of graphite/epoxy technology is sufficient to assure successful graphite application to current production satellite programs with a minimum of risk N B

A83-24891#
SCATHA CONDUCTIVE SPACECRAFT MATERIALS DEVELOPMENT
W L LEHN (USAF, Materials Laboratory, Wright-Patterson AFB, OH) Journal of Spacecraft and Rockets, vol 20, Mar-Apr 1983, p 182-186 refs

(Previously cited in issue 12, p 1868, Accession no A82-27097)

A83-29735#
SPACE RADIATION ENVIRONMENT EFFECTS ON SELECTED PROPERTIES OF ADVANCED COMPOSITE MATERIALS
V F MAZZIO (Boeing Vertol Co, Philadelphia, PA) and P W JUNEAU, JR (General Electric CO, Space Div, Philadelphia, PA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 61-67
(Contract F33615-79-C-5114)
(AIAA 83-0803)

Test equipment and techniques have been developed in order to describe the effects of the space environment on fiber-reinforced plastic composite materials Attention is given to the features and performance of the vacuum chamber-Van de Graaff radiation facility employed, its exposure dosimetry, the preparation of the test specimens, their test rotating drum, and the levels of specimen irradiation and moisture saturation tested The samples were P75-S pitch graphite fiber/CE339, T300 graphite fiber/934, GY70 graphite fiber/X-30, and Kevlar 49 Aramid/5209 composites O C

A83-29754#
BERYLLIUM APPLICATION FOR SPACECRAFT DEPLOYABLE SOLAR ARRAY BOOMS
A W SHEFFLER (RCA, Astro Electronics, Princeton, NJ) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 263-268 refs
(AIAA 83-0867)

The design and development of beryllium support booms are presented for the deployed solar arrays on geosynchronous communication satellites The design requirements and material selection are discussed in terms of volume, constraints, stiffness, strength and weight along with a trade-off of beryllium versus graphite/epoxy The unique characteristics of high isotrophic stiffness and low weight make beryllium ideally suited to the support of large deployable solar array appendages The overall stiffness of the deployed array must be sufficient to maintain dynamic stability with the spacecraft attitude control systems while maintaining a minimum weight design Special consideration is given to the cost and weight trade-off as applied to commercial satellites where the earnings per year of operation are quite high The flight history is presented for beryllium applications on the RCA Satcom series of communication satellites A brief description is given of the design and fabrication details as well as the quality assurance acceptance testing of the material and the brazed assembly Qualification of the beryllium boom assemblies is conducted at spacecraft level sine, acoustic and shock testing at qualification levels Author

A83-29763#
DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYIMIDE COMPOSITE JOINTS AND ATTACHMENTS
J B CUSHMAN and D E SKOUMAL (Boeing Aerospace Co, Seattle, WA) IN Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers Part 1 New York, American Institute of Aeronautics and Astronautics, 1983, p 337-347 refs
(AIAA 83-0907)

The results of a program design to extend the current epoxy matrix composite technology in joint and attachment design to include the high-temperature polyimide matrix composites and adhesives are presented In particular, the design, development, and evaluation of graphite/polyimide attachments that may be used for high-speed aircraft and space transportation systems operating in the 116-589 K temperature range are discussed It is shown that the fabrication of graphite/polyimide attachment joints that will sustain the load levels specified for control surfaces of advanced aerospace vehicles and space transportation systems is possible with currently available materials V L

N83-12165*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
DURABILITY OF SPACECRAFT MATERIALS
D R TENNEY *In its* Advan Mater Technol p 357-380 Nov 1982 refs
Avail NTIS HC A19/MF A01 CSCL 22B

Research efforts are reviewed on the space durability of materials, including radiation effects on polymer matrix composites and films, dimensional stability of polymer matrix composites and tension-stabilized cables, and thermal control coatings Research to date has concentrated on establishing a fundamental understanding of space environmental effects on current graphite-reinforced composites and polymer systems, and development of analytical models to explain observed changes in mechanical, physical, and optical properties As a result of these research efforts, new experimental facilities have been developed to simulate the space environment and measure the observed property changes Chemical and microstructural analyses have also been performed to establish damage mechanisms and the limits for accelerated testing The implications of these results on material selection and system performance are discussed and additional research needs and opportunities in the area of tougher resin/matrix and metal/matrix composites are identified B W

N83-12450*# Boeing Aerospace Co, Seattle, Wash
DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYIMIDE COMPOSITE JOINTS AND ATTACHMENTS Data Report
J B CUSHMAN, S F MCCLESKEY, and S H WARD Jul 1982 314 p refs
(Contract NAS1-15644)
(NASA-CR-165955, NAS 1 26 165955) Avail NTIS HC A14/MF A01 CSCL 20K

The design, analysis, and testing performed to develop four types of graphite/polyimide (Gr/PI) bonded and bolted composite joints for lightly loaded control surfaces on advanced space transportation systems that operate at temperatures up to 561 K (550 F) are summarized Material properties and small specimen tests were conducted to establish design data and to evaluate specific design details Static discriminator tests were conducted on preliminary designs to verify structural adequacy Scaled up specimens of the final joint designs, representative of production size requirements, were subjected to a series of static and fatigue tests to evaluate joint strength Effects of environmental conditioning were determined by testing aged (125 hours at 589 K (600 F)) and thermal cycled (116 K to 589 K (-250 F to 600 F), 125 times) specimens It is concluded Gr/PI joints can be designed and fabricated to carry the specified loads Test results also indicate a possible resin loss or degradation of laminates after exposure to 589 K (600 F) for 125 hours M G

N83-14175# European Space Agency, Paris (France) Mechanical Systems Div
GUIDELINES FOR CARBON AND OTHER ADVANCED FIBER PREPREG PROCUREMENT SPECIFICATIONS
Aug 1982 35 p Prepared in cooperation with ESTEC, Noordwijk, Netherlands
(ESA-PSS-58-ISSUE-1, ISSN-0379-4059) Avail NTIS HC A03/MF A01

Information to assist in the preparation of specifications for the procurement of advanced composite prepregs is given The guideline is biased towards the special requirements of carbon fiber reinforced plastics for use in spacecraft structures The subjects discussed include definitions, classification of prepregs, requirements for qualification and batch testing, laminate requirements, test methods and specifications structure Author (ESA)

N83-14272*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
METAL ION-CONTAINING EPOXIES
D M STOAKLEY and A K ST CLAIR Oct 1982 13 p refs Presented at the 34th Southeastern Reg Meeting of the Am Chem Soc, Birmingham, Ala, 3-5 Nov 1982
(NASA-TM-84567, NAS 1 15 84567) Avail NTIS HC A02/MF A01 CSCL 11G

A variety of metallic and organometallic complexes to be used as potential additives for an epoxy used by the aerospace industry as a composite matrix resin were investigated A total of 9 complexes were screened for compatibility and for their ability to accelerate or inhibit the cure of a highly crosslinkable epoxy resin Methods for combining the metallic complexes with the resin were investigated, gel times recorded, and cure exotherms studied by differential scanning calorimetry Glass transition temperatures of cured metal ion containing epoxy castings were determined by thermomechanical analysis Thermal stabilities of the castings were determined by thermogravimetric analysis Mechanical strength and stiffness of these doped epoxies were also measured E A K

N83-14364# Giessen Univ (West Germany) Inst of Physics
CHARGING BEHAVIOR OF SPACECRAFT MATERIALS UNDER ELECTRON IRRADIATION
K W BESCHERER, K H GROH, H W LOEB, and N K NIKOLAIZIG *In* ESA 2nd ESTEC Spacecraft Electromag Compatibility Seminar p 155-160 Jul 1982 refs
Avail NTIS HC A10/MF A01
A substorm simulation facility is described, and investigations of the surface potential of Teflon, Kapton, and thermal control paints under electron irradiation are outlined Electron irradiation up to 25KeV at a current density up to 10 nA/sqcm is possible Current density uniformity is 20% for a sample surface of 1sqm Tests indicate that irradiation induces higher surface conductivity, but that bulk conductivity is relatively unchanged No arc discharges are observed for Teflon samples thicker than 5 mil, since they reach their equilibrium potential Author (ESA)

N83-14738# British Aerospace Dynamics Group, Bristol (England)
ANTI-STATIC COAT FOR SOLAR ARRAYS
C N FELLAS *In* ESA Photovoltaic Generators in Space p 305-307 Jun 1982 refs
Avail NTIS HC A15/MF A01
A Kapton based composite material, suitable as a substrate for flexible solar arrays, was designed, constructed and tested under electron energies ranging from 5 to 30 keV The rear of the array under adverse eclipse conditions (-197 C) produced voltages well below the discharge threshold An antistatic coat suitable as a front cover for solar arrays is also described The thermal and optical transmission characteristics were tested and are satisfactory, but the UV and particle degradation of the Tedlar material needs to be evaluated Author (ESA)

N83-15351*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
NONTERRESTRIAL UTILIZATION OF MATERIALS: AUTOMATED SPACE MANUFACTURING FACILITY
In its Advan Automation for Space Missions p 77-188 Nov 1982 refs
Avail NTIS HC A17/MF A01 CSCL 22B
Four areas related to the nonterrestrial use of materials are included (1) material resources needed for feedstock in an orbital manufacturing facility, (2) required initial components of a nonterrestrial manufacturing facility, (3) growth and productive capability of such a facility, and (4) automation and robotics requirements of the facility Author

N83-15364*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PMR POLYIMIDE COMPOSITES FOR AEROSPACE APPLICATIONS
T T SERAFINI 1982 22 p refs Presented at the 1st Tech Conf on Polyimides, Ellenville, N Y, 10-12 Nov 1982, sponsored by the Society of Plastics Engineers, Inc
(NASA-TM-83047, E-1494, NAS 1 15 83047) Avail NTIS HC A02/MF A01 CSCL 11D
Fiber reinforced PMR polyimides are finding increased acceptance as engineering materials for high performance structural applications Prepreg materials based on this novel class of highly processable, high temperature resistant polyimides, are commercially available and the PMR concept was incorporated in several industrial applications The status of PMR polyimides is reviewed Emphasis is given to the chemistry, processing, and applications of the first generation PMR polyimides known as PMR-15 S L

N83-15832*# Jet Propulsion Lab, California Inst of Tech, Pasadena
A PRELIMINARY EVALUATION OF A POTENTIAL SPACE WORTH ENCAPSULANT
J SCOTT-MONCK *In* NASA Lewis Research Center Space Photovoltaic Res and Technol 1982 High Efficiency, Radiation Damage, and Blanket Technol p 231-236 1982 refs
Avail NTIS HC A12/MF A01 CSCL 10A
A new polymer polyimide possessing optical and mechanical properties potentially suitable for space applications now exists A preliminary evaluation of the material indicates that in its present state of development, the polyimide is not ready for space qualification Further efforts to increase molecular weight and purify the consituents used to synthesize it are warranted Activities addressing these needs are now being pursued If these approaches prove successful, additional testing will take place with an emphasis on synergistic effects L F M

N83-15869# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
OVERVIEW OF HIGH-TEMPERATURE MATERIALS FOR HIGH-ENERGY SPACE POWER SYSTEMS Final Report
N T SAUNDERS *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 39 p 1982
Avail NTIS HC A99/MF A01 CSCL 10B
The current state of technology and some of the more pressing research needs and challenges associated with the possible use of high temperature materials in future high energy space power systems are discussed Particularly, emphasis is on the need to improve and quantify the fundamental understanding of the effects of the following (1) fast neutron radiation on the properties and behavior of nuclear reactor fuels and claddings, and (2) long term, high temperature, space (vacuum) exposure on the properties of refractory metals considered for use as structural materials in various power conversion systems M G

N83-15882*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
MATERIALS TECHNOLOGY FOR LARGE SPACE STRUCTURES Final Report
C P BLANKENSHIP and D R TENNEY *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 38 p 1982 refs
Avail NTIS HC A99/MF A01
Several of the key material technology needs that were identified for large space structures are outlined They include lightweight structural materials, materials durability in the space environment, and some special aspects of materials fabrication technology Examples of current materials research directed toward large space structures are described Additional research needs and opportunities are noted A short bibliography is included of selected references that describe large space structural concepts and related technology needs in detail R J F

N83-16396*# North Carolina State Univ, Raleigh
EFFECT OF IONIZING RADIATION ON THE MECHANICAL AND STRUCTURAL PROPERTIES OF GRAPHITE FIBER REINFORCED COMPOSITES Ph.D. Thesis
K W WOLF 1982 160 p refs Sponsored by NASA
(NASA-CR-169651, NAS 1 26 169651) Avail NTIS HC A08/MF A01
Graphite/epoxy (T300/5208) and graphite/polyimide composites (C6000/PMR 15) were exposed to various levels of 0 5 MeV electron radiation with the maximum dose being 10,000 Mrad A three point bending test was used to evaluate the ultimate stress and modulus of the composites In all composites except transverse samples of C6000/PMR 15 ultimate stress values remained approximately constant or increased slightly The modulus values remained approximately constant for all composite types regardless of the radiation level Interfacial aspects of composites were studied Interlaminar shear tests were performed on T300/5208 and C6000/PMR 15 composites irradiated to 10,000

Mrad There was an initial increase in interlaminar shear strength (up to 1,000 Mrad) followed by a sharp decrease with further radiation exposure Using scanning electron microscopy no visual differences in the mode of fracture could be detected between ruptured control samples and those exposed to various levels of radiation Electron spectroscopy for chemical analysis (ESCA) revealed little change in the surface elements present in control and highly irradiated T300/5208 composite samples Author

N83-16786*# Boeing Aerospace Co, Seattle, Wash
DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYMIDE COMPOSITE JOINTS AND ATTACHMENTS: SUMMARY Final Report
J B CUSHMAN, S F MCCLESKEY, and S H WARD Washington NASA Jan 1983 91 p refs
(Contract NAS1-15644)
(NASA-CR-3601, NAS 1 26 3601) Avail NTIS HC A05/MF A01 CSCL 20K

The design, analysis and testing performed to develop four types of graphite/polyimide (Gr/PI) bonded and bolted composite joints for lightly loaded control surfaces on advanced space transportation systems that operate at temperatures up to 561K (550 F) are summarized Material properties and 'small specimen' tests were conducted to establish design data and to evaluate specific design details 'Static discriminator' tests were conducted on preliminary designs to verify structural adequacy Scaled up specimens of the final joint designs, representative of production size requirements, were subjected to a series of static and fatigue tests to evaluate joint strength Effects of environmental conditioning were determined by testing aged (125 hours 589K (600 F)) and thermal cycled (116K to 589K (-250 F to 600 F), 125 times) specimens It is concluded Gr/PI joints can be designed and fabricated to carry the specified loads Test results also indicate a possible resin loss or degradation of laminates after exposure to 589K (600 F) for 125 hours S L

N83-16787*# Boeing Aerospace Co, Seattle, Wash
TEST AND ANALYSIS OF CELION 3000/PMR-15, GRAPHITE/POLYIMIDE BONDED COMPOSITE JOINTS: SUMMARY Final Report
J B CUSHMAN, S F MCCLESKEY, and S H WARD Washington NASA Jan 1983 75 p refs
(Contract NAS1-15644)
(NASA-CR-3602, NAS 1 26 3602) Avail NTIS HC A04/MF A01 CSCL 20K

Standard single lap, double lap and symmetric step lap bonded joints of Celion 3000/PMR-15 graphite/polyimide composite were evaluated Composite to composite and composite to titanium joints were tested at 116K (-250 F), 294K (70 F) and 561K (550 F) Joint parameters evaluated were lap length, adherend thickness, adherend axial stiffness, lamina stacking sequence and adherend tapering Tests of advanced joint concepts were also conducted to establish the change in performance of preformed adherends, scalloped adherends and hybrid systems Special tests were conducted to establish material properties of the high temperature adhesive, designated A7F, used for bonding Most of the bonded joint tests resulted in interlaminar shear or peel failures of the composite There were very few adhesive failures Average test results agree with expected performance trends for the various test parameters Results of finite element analyses and of test/analysis correlations are also presented S L

N83-17597*# Rensselaer Polytechnic Inst, Troy, N Y School of Engineering
COMPOSITE STRUCTURAL MATERIALS Semiannual Progress Report, 30 Apr. - 30 Sep. 1982
G S ANSELL, R G LOEWY, and S E WIBERLEY Dec 1982 167 p refs
(Contract NGL-33-018-003)
(NASA-CR-169859, NAS 1 26 169859, SAR-43) Avail NTIS HC A08/MF A01 CSCL 11D

The promise of filamentary composite materials, whose development may be considered as entering its second generation, continues to generate intense interest and applications activity Fiber reinforced composite materials offer substantially improved performance and potentially lower costs for aerospace hardware Much progress has been achieved since the initial developments in the mid 1960's Rather limited applications to primary aircraft structure have been made, however, mainly in a material-substitution mode on military aircraft, except for a few experiments currently underway on large passenger airplanes in commercial operation To fulfill the promise of composite materials completely requires a strong technology base NASA and AFOSR recognize the present state of the art to be such that to fully exploit composites in sophisticated aerospace structures, the technology base must be improved This, in turn, calls for expanding fundamental knowledge and the means by which it can be successfully applied in design and manufacture L F M

N83-17621# Grumman Aerospace Corp, Bethpage, N Y Automated Manufacturing Systems Development Section
SPECIFIC EXAMPLES OF AEROSPACE APPLICATIONS OF COMPOSITES
R HADCOCK and J HUBER *In* AGARD Pract Considerations of Design, Fabric and Tests for Composite Mater 13 p Sep 1982 refs
Avail NTIS HC A09/MF A01

The state of the art for the use of composites in both prototype and production, structural and nonstructural aerospace components is reviewed Historic material usage trends for both commercial and military applications are presented The applications show the evolution of composite components from relatively simple parts to the current, large and complex structures The use of composite materials in the new generation of commercial transport aircraft is presented Specific areas of application, such as spoilers, flaps and fairings, are discussed for impact on part weight, type of construction, and material selection factors Selected, major composite programs for military aircraft, are reviewed Composite materials used in these aircraft are analyzed with respect to the percent of the structural weight, type of material utilized, areas of application, type of construction and special manufacturing processes used in production The test procedures utilized to evaluate composite structures are reviewed E A K

N83-17711*# IIT Research Inst, Chicago, Ill
SPACE STABLE THERMAL CONTROL COATINGS Final Report, 1 Mar. 1976 - 30 Apr. 1982
Y HARADA Nov 1982 94 p refs
(Contract NAS8-31906)
(NASA-CR-170719, NAS 1 26 170719, IITRI-M06020-62) Avail NTIS HC A05/MF A01 CSCL 11C

A specification quality zinc orthotitanate coating was developed This silicate-bonded Zn_2TiO_4 coating is discussed The effects of precursor chemistry, precursor mixing procedures, stoichiometry variations, and of different heat treatments on the physical and optical properties of Zn_2TiO_4 are investigated Inorganic silicates are compared to organic silicone binder systems The effects of pigment to binder ratio, water content, and of different curing procedures on the optical and physical properties of Zn_2TiO_4 potassium silicate coatings are also studied Environmental tests were conducted to determine the UV vacuum stability of coatings for durations up to 5000 equivalent Sun hours S L

N83-17713*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
THE DEVELOPMENT OF AEROSPACE POLYIMIDE ADHESIVES
A K ST CLAIR and T L ST CLAIR Jan 1983 28 p refs
Presented at the 1st Tech Conf on Polyimides, Ellenville, N Y, Nov 1982
(NASA-TM-84587, NAS 1 15 84587) Avail NTIS HC A03/MF A01 CSCL 11A

Few materials are available which can be used as aerospace adhesives at temperatures in the range of 300 C The Materials Division at NASA-Langley Research Center developed several high temperature polyimide adhesives to fulfill the stringent needs of current aerospace programs These adhesives are the result of a decade of basic research studies on the structure property relationships of both linear and addition aromatic polyimides The development of both in house and commercially available polyimides is reviewed with regards to their potential for use as aerospace adhesives Author

N83-18779# European Space Agency, Paris (France)
SPACECRAFT MATERIALS IN A SPACE ENVIRONMENT
A ROLFO, comp, J DAUPHIN, comp, and T D GUYENNE, comp Jul 1982 337 p refs Partly in ENGLISH and FRENCH Proc held in Toulouse, 8-11 Jun 1982, sponsored by ESA, CNES and CERT
(ESA-SP-178, ISSN-0379-6566) Avail NTIS HC A15/MF A01
Various topics concerning the effects of the space environment on materials and the development of spacecraft materials are addressed Theoretical and experimental analyses of the spacecraft contamination process, radiation effects, spacecraft charging, and measurement techniques and failure analysis are discussed

N83-18780# European Space Agency, Toulouse (France) Earth Observation Program Office
MATERIAL PROBLEMS ON SATELLITES
P G EDWARDS and D LENNERTZ *In its* Spacecraft Mater in a Space Environ p IX-XIV Jul 1982
Avail NTIS HC A15/MF A01
Some of the materials problems encountered during the execution of various projects are outlined, such problems including contamination of optical payloads, structural material failures, electrically oriented problems, and advanced materials/technology developments Areas of concern which project managers need to address are identified and general guidelines for reducing the number and effects of materials-related problems arising during a project life cycle are recommended M G

N83-18781# AEG-Telefunken, Wedel (West Germany) Neue Technologien Raumfahrt
RTV-S 695, A NEW ADHESIVE FOR SOLAR CELL COVER GLASSES
J KOCH *In* ESA Spacecraft Mater in a Space Environ p 3-7 Jul 1982 refs Sponsored by Bundesministerium fuer Forschung und Technologie
Avail NTIS HC A15/MF A01
A transparent solar cell coverglass adhesive was developed and investigated The adhesive bases on components of the solar cell adhesive RTV-S 691 Characteristic data which should be realized to obtain a product which is adapted to the application as coverglass adhesive were defined A test batch was manufactured and investigated in detail The elastomechanial properties were determined and experiences in manufacturing CICs with this adhesive were collected The experiences with this test batch were so encouraging that a qualification test program was performed with an adhesive lot which was manufactured according to a frozen manufacturing procedure Author

N83-18782*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md
A TECHNIQUE FOR REDUCING THE OUTGASSING OF SILICONE COMPOUNDS
J J PARK and C H CLATTERBUCK *In* ESA Spacecraft Mater in a Space Environ p 9-12 Jul 1982 refs
Avail NTIS HC A15/MF A01
A technique was developed to heat silicone resins in vacuum and thereby remove the low molecular weight molecules which contribute to the high outgassing of the untreated resins The technique was successfully applied to two silicone resins Heating the monomer to a temperature about 398 K (125 C) in a vacuum of about 0 0001 N/sq m removes about 10% of the resin weight, and the resultant resin when catalyzed can meet the outgassing requirements when tested according to ASTM E-595 The physical properties of RTV-615 when devolatilized at 398 K (125 C) or at 423 K (150 C) were measured M G

N83-18783# European Space Research and Technology Center, Noordwijk (Netherlands) Section Materiaux
FLEXIBLE SOLAR REFLECTORS: INVESTIGATION AIMED AT IMPROVING STABILITY IN SPACE ENVIRONMENT [REFLECTEURS SOLAIRES SOUPLES: ETUDE EN VUE D'AMELIORER LA STABILITE EN AMBIANCE SPATIALE]
F BOUTON *In* ESA Spacecraft Mater in a Space Environ p 13-20 Jul 1982 refs In FRENCH
Avail NTIS HC A15/MF A01
Flexible second surface mirrors based on Teflon FEP covered with a transparent conducting layer present problems of stability during thermal cycling tests because of the great difference between the thermal expansion coefficient of the layer and that of the Teflon FEP An intermediate layer of transparent crystalline or amorphous material with a thermal expansion coefficient which included that of the Teflon and that of its conducting coating was deposed between the covering and the Teflon to avoid the greatest number of fractures Transl by A R H

N83-18784# Centre National d'Etudes Spatiales, Toulouse (France)
DEVELOPMENT OF NEW THERMAL CONTROL COATINGS FOR SPACE VEHICLES [DEVELOPMENT DE NOUVEAUX REVETEMENTS DE CONTROLE THERMIQUE POUR LES VEHICULES SPATIAUX]
J C GUILLAUMON *In* ESA Spacecraft Mater in a Space Environ p 21-26 Jul 1982 refs In FRENCH, ENGLISH summary
Avail NTIS HC A15/MF A01
Properties of several paints are described Various binders (silicones and silicates) were selected depending on irradiation stability and various pigments (zinc oxide, zinc orthotitanate, zinc orthostannate, tin orthotitanate) The paints are grouped in two categories non conductive paints and electrically conductive paints The non conductive paints are characterized by their low outgassing Zinc orthotitanate bonded silicate paint can be applied on large surfaces (1 sqm) in normal atmospheric conditions Good thermooptical properties were measured solar absorption = 0 09 to 0 12 and hemispherical emittance = 0 90 Three electrically conductive paints are described white, aluminum, and black types The white conductive paints were obtained from silicone binders and mixtures of pigments The surface resistivities are low for the values of solar absorption between 0 22 to 0 30 and hemispherical emittance = 0 82 The best stability of paint under UV irradiations is obtained with a Rhodorsil 10336 binder bonded with zinc orthostannate M G

N83-18785# European Space Research and Technology Center, Noordwijk (Netherlands)
SOME CONSIDERATIONS ON LUBRICANTS FOR USE IN SPACECRAFT
H M BRISCOE *In* ESA Spacecraft Mater in a Space Environ p 27-34 Jul 1982 refs
Avail NTIS HC A15/MF A01
The lubricant requirements for a number of spacecraft applications are summarized A number of lubricants and lubrication systems which can meet these requirements are reviewed Both dry and liquid lubrication systems are considered and some test results are referenced The importance of ensuring that any lubrication system used in space is fully codified and documented as a process and thoroughly qualified by a strictly controlled test program to ensure repeatability of performance is stressed A number of recommendations are offered M G

N83-18787# European Space Research and Technology Center, Noordwijk (Netherlands) Materials Section
OUTGASSING AND CONTAMINATION PREDICTIONS
J DAUPHIN *In* ESA Spacecraft Mater in a Space Environ p 55-69 Jul 1982 refs
Avail NTIS HC A15/MF A01
Some physical grounds for the long time extrapolation of outgassing and contamination data obtained experimentally over relatively short periods of time are established On the basis of a

simplified diffusion approach a bi-exponential law of the form W = A (1 - e -beta t) + C (1 - e -gamma t) is obtained as the best contender to describe the outgassing phenomenon under well defined experimental conditions Sources of error and possible corrections to the experimental data are reviewed Test data are presented in support of this theoretical approach M G

N83-18788# Lockheed Missiles and Space Co, Sunnyvale, Calif

A TRANSIENT MULTILAYER ADSORPTION ANALYSIS

M C FONG, C K LIU, and A P M GLASSFORD *In* ESA Spacecraft Mater in a Space Environ p 71-80 Jul 1982 refs

Avail NTIS HC A15/MF A01

A transient multimolecular layer absorption model was developed to describe the time variations of layer by layer adsorption buildup for a smooth substrate under molecular flux impingement the analytical model constitutes a nonequilibrium Brunauer-Emmett-Teller (BET) theory, and the transient BET adsorption equations were derived based on both statistical mechanics and kinetic theory A numerical method was developed to solve the resulting system of linear differential equations The transient model is demonstrated by presentation of the predicted kinetic behavior of low temperature (73 57 K) N2 adsorption on KCl crystal with asymptotic values satisfying experimental equilibrium BET data Based on a layer by layer desorption energy variation model, the theory/data correlation indicates that the multilayer adsorption kinetics theory is valid up to about 3 x 10 to the -7th power g/sq cm deposit, beyond which the processes of nucleation, migration, and droplet formation probably become predominant M G

N83-18789# Centre National d'Etudes Spatiales, Toulouse (France)

SIMULATION OF IN FLIGHT CONTAMINATION USING THE CONTAMI 2 SOFTWARE [SIMULATION DE LA CONTAMINATION EN VOL PAR LE LOGICIEL CONTAMI 2]

J GUILLIN and J F GORY *In* ESA Spacecraft Mater in a Space Environ p 81-88 Jul 1982 refs In FRENCH, ENGLISH summary

Avail NTIS HC A15/MF A01

In order to forecast the outgassing effects of materials in space environment, a contamination computer model was developed Each material is divided in two components, the first one with a high outgassing rate, and the second one with a low rate The kinetics of outgassing and reemission of materials is supposed to be of first order, and the sources to emit and reemit diffusely, only for the free molecular flow regime The structure considered may be modeled with three hundred contamination nodes maximum, and for each node, the expressions of outgassed, reflected and deposited fluxes are given The CONTAMI 2 software, based on this model, computes deposits depending on time, geometry variation, and temperature changes of each node The contamination of the external structure of the TELECOM 1 satellite by an adhesive, a paint, and a carbon fiber composite is used as an example M G

N83-18790# Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France)

EFFECT OF CONTAMINATION ON THE CHARGING OF SILICA FABRICS

L LEVY and A PAILLOUS *In* ESA Spacecraft Mater in a Space Environ p 89-101 Jul 1982 refs

Avail NTIS HC A15/MF A01

The surface potential values of silica fabrics and composites silica fabric/FEP/Teflon Aluminum are enhanced when successive irradiations are carried out with low energy electrons under vacuum Comparative studies were performed in identical conditions on a fabric specimen receiving a long irradiation and a nonirradiated specimen in the same vacuum environment Contaminant layers were deposited ex-situ onto fabrics and ITO/Kapton samples, the electrostatic behavior of these contaminated samples was compared to the clean samples The charging performance of silica fabrics appears to be very sensitive to a contamination plus irradiation effect M G

N83-18793# Aerospace Corp, El Segundo, Calif

CURRENT FLIGHT RESULTS FROM THE P78-2 (SCATHA) SPACECRAFT CONTAMINATION AND COATINGS DEGRADATION EXPERIMENT

D F HALL *In* ESA Spacecraft Mater in Space Environ p 143-148 Jul 1982 refs

(Contract F04701-81-C-0082)

Avail NTIS HC A15/MF A01

An experiment on board the P78-2 spacecraft had calorimetrically mounted thermal control coating (TCC) samples and temperature controlled quartz crystal microbalances (TQCMs) The solar absorptance of the TCC samples is deduced from on orbit measurements of sample temperatures and prelaunch measurements of thermal emittances and residual heat leaks Four of these samples are approximately space stable two aluminum, one gold, and one fused quartz mirror Increases in the solar absorptance of these samples and of the mass recorded by the TQCMs are interpreted as contamination acquired on orbit Nonline of sight contamination transport mechanisms occur at geosynchronous altitudes and mirrors are less sensitive to contamination (at least that from P78-2) than is frequently assumed R J F

N83-18795# European Space Research and Technology Center, Noordwijk (Netherlands) Materials Section

OPTICAL SOLAR REFLECTORS TECHNOLOGY: RECENT DEVELOPMENTS AND PROBLEMS

J BOSMA *In* ESA Spacecraft Mater in a Space Environ p 159-173 Jul 1982 refs

Avail NTIS HC A15/MF A01

A survey of radiator solar absorptance variations for a number of spacecraft are given A breakdown of plausible reasons for excess degradation is noted, mainly contamination related The results of a test program to quantify ground contamination effects on solar radiator panels are presented Furthermore a description is given of funded contact to study long term radiation effects on contaminant layers Performance results of recently developed optical solar refector types are given R J F

N83-18798# Jet Propulsion Lab, California Inst of Tech, Pasadena

MECHANISMS OF INTERACTIONS OF ENERGETIC ELECTRONS WITH EPOXY RESINS

A GUPTA, D R COULTER, F D TSAY, and J MOACANIN *In* ESA Spacecraft Mater in a Space Environ p 191-194 Jul 1982

Avail NTIS HC A15/MF A01

The mechanism of deactivation of energy of excitation in a resin system was investigated on optical excitation as well as excitation by high energy electrons This mechanism involves formation of excited state complexes, known as exciplexes which have a considerable charge transfer character This mechanism will be used to develop a degradation model for epoxy matrix materials deployed in a space environment R J F

N83-18801# Toronto Univ (Ontario) Inst for Aerospace Studies

SPACE ENVIRONMENT EFFECTS ON POLYMER MATRIX COMPOSITE STRUCTURES

R C TENNYSON (Commun Res Centre, Ottawa) and D G ZIMCIK *In* ESA Spacecraft Mater in a Space Environ p 215-226 Jul 1982 refs

Avail NTIS HC A15/MF A01

An extensive study was undertaken to evaluate the combined effects of vacuum, thermal cycling, combined ultraviolet (UV) radiation, and high energy electron bombardment on selected polymer matrix composites The materials investigated to date include graphite epoxy, Kevlar epoxy, and boron epoxy Data was obtained for exposure periods exceeding 400 days in hard vacuum and over 180 equivalent sun days of UV radiation During this time, in-situ measurements of coefficients of thermal expansion (CTE), moduli, creep compliance, and material damping factors were made using specialized fixtures within the space simulators Analytical models were developed to demonstrate the usefulness of these data in predicting the response of arbitrary laminates in terms of their CTE, damping, and creep behaviour R J F

N83-18803# Communications Research Centre, Ottawa (Ontario) Dept of Communications
DAMAGE AND DETERIORATION OF TEFLON SECOND-SURFACE MIRRORS BY SPACE SIMULATED ELECTRON IRRADIATION
O BEROLO *In* ESA Spacecraft Mater in a Space Environ p 231-240 Jul 1982 refs
Avail NTIS HC A15/MF A01
Damage and outsputtered surface contaminants were examined on Teflon second-surface mirrors which were subjected to electrostatic discharges in a laboratory-simulated spacecraft-charging environment Thirteen different types of damage were identified through optical and scanning-electron-microcope examinations Outsputtered surface contaminants were analysed using a scanning-Auger-microscope The conditions causing severe second-surface mirror deterioration identified The reflective performances of a damaged and an undamaged second-surface mirror were evaluated in the solar spectrum range The thermal performance of these samples was compared with a standard aluminum plate R J F

N83-18804# Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France)
EXPERIMENTAL STUDY OF THERMAL CONTROL MATERIAL CHARGING AND DISCHARGING [ETUDES EXPERIMENTALES DE CHARGE ET DE DECHARGE DES MATERIAUX DE CONTROLE THERMIQUE]
L LEVY, A PAILLOUS, and J P CATANI *In* ESA Spacecraft Mater in a Space Environ p 243-251 Jul 1982 refs In FRENCH
Avail NTIS HC A15/MF A01
The electrostatic behavior of different thermal control materials (such as those containing Kapton and Teflon) under electron bombardment is explained partly by a capacity model of the material, and partly by the relative importance of the property of secondary emission, of intrinsic conductivity, of conductivity induced by radiation, and of conductivity induced by secondary emission The measured polarity and amplitude of discharge currents are, moreover, coherent with the amplitude of electric currents associated with these discharges, and with the concept of discharge by injection of negative charges on the surface at its exterior These ejected charges create an electric dipole with responsible variable movement of the measured electric fields
Transl by A R H

N83-18806*# Toronto Univ (Ontario) Dept of Electrical Engineering
PHENOMENOLOGY OF SURFACE ARCS ON SPACECRAFT DIELECTRIC MATERIALS
K G BALMAIN, M GOSSLAND, R D REEVES, and W G KULLER (AFWL, Albuquerque, N Mex) in ESA Spacecraft Mater in a Space Environ p 263-268 Jul 1982 refs Sponsored in cooperation with the Natural Sciences and Engineering Research Council of Canada
(Contract NSG-7647)
Avail NTIS HC A15/MF A01 CSCL 22B
For electron beam incidence on large specimens of Kapton thermal blanket material, surface arc discharges are shown to cause damage consisting of punchthrough holes which act as focal points for other types of damage, including subsurface tunnels, blowout holes and surface breakup Under electron bombardment, dielectric sheet specimens separated by a gap are shown to discharge simultaneously Teflon specimens which have been brushed or rubbed are shown to exhibit directional guidance of discharge arcs, and this phenomenon has been used to generate straight arcs whose velocities have been measured optically
Author

N83-18807# York Univ (England) Dept of Physics
MULTIPLE FLOATING POTENTIALS, THRESHOLD-TEMPERATURE EFFECTS AND BARRIER EFFECTS IN HIGH-VOLTAGE CHARGING OF EXPOSED SURFACES ON SPACECRAFT
J G LAFRAMBOISE, M KAMITSUMA, and R GODARD (Roy Mil Coll, Kingston, Canada) *In* ESA Spacecraft Mater in a Space Environ p 269-275 Jul 1982 refs Sponsored in cooperation with the Natural Sciences and Engineering Research Council of Canada
(Contract AF-AFOSR-2962-76)
Avail NTIS HC A15/MF A01
A new property of spacecraft surface materials, the 'threshold temperature for high-voltage charging', is defined A table of threshold temperatures, calculated for various spacecraft surface materials, is presented This property explains and unifies several recently-identified phenomena affecting spacecraft charging, including the existence of multiple floating potentials for certain spacecraft surfaces in certain external environments, 'sensitivity' effects in the numerical prediction of spacecraft potentials, sudden jumps in both observed and simulated spacecraft potentials in slowly-varying environments, and observed 'threshold' effects in high-voltage charging In addition, knowledge of the threshold temperature for proposed or existing surface materials provides a simple, effective way to evaluate their charging behaviour when exposed to various space environments Author

N83-18810# European Space Research and Technology Center, Noordwijk (Netherlands) Section Materiaux,
APPLICATION OF THERMOGRAVITY TO THE STUDY OF POLYMER MATERIAL THERMAL STABILITY [APPLICATION DE LA THERMOGRAVIMETRIE A L'ETUDE DE LA STABILITE THERMIQUE DES MATERIAUX POLYMERIQUES]
M DEBEIR in ESA Spacecraft Mater in a Space Environ p 293-303 Jul 1982 refs In FRENCH
Avail NTIS HC A15/MF A01
Thermogravimetry, a technique for the continuous measurement of the mass variations of an evolving chemical system subjected to a temperature variation and regulated by a predetermined program, allows the study of the thermal stability and evolution of polymers as well as of the kinetics of associated reactions Topics covered include the use of the thermobalance, reactions of solids in various atmospheres, determining activation energy using the Arrhenius law, interpreting isotherm thermogravimetry, and interpreting thermogravimetry with a linear variation of temperature Results of investigations undertaken on polymeric materials for space use are examined The materials discussed include hydrated carbon phenolic composite the the MAGE nozzle, hydrated oxalate of calcium, RTV 566, aramide epoxides, and STYCAST 113, CPC 41, 3050, 1263, and 1090 Transl by A R H

N83-18853*# Carnegie-Mellon Univ, Pittsburgh, Pa Dept of Mechanical Engineering
RESEARCH PRIORITIES FOR ADVANCED FIBROUS COMPOSITES
K J BAUMANN and J L SWEDLOW Jul 1981 209 p refs
(Contract NSG-3172)
(NASA-CR-165414, NAS 1 26 165414, SM-79-15A) Avail NTIS HC A10/MF A01 CSCL 11D
Priorities for research in advanced laminated fibrous composite materials are presented Supporting evidence is presented in two bodies, including a general literature survey and a survey of aerospace composite hardware and service experience Both surveys were undertaken during 1977-1979 Specific results and conclusions indicate that a significant portion of contemporary published research diverges from recommended priorites Author

08

ASSEMBLY CONCEPTS

Includes automated manipulator techniques, EVA, robot assembly, teleoperators, and equipment installation

A83-12771#
ON THE DYNAMIC ANALYSIS AND BEHAVIOR OF INDUSTRIAL ROBOTIC MANIPULATORS WITH ELASTIC MEMBERS
W H SUNADA (Hughes Aircraft Co, Culver City, CA) and S DUBOWSKY (California University, Los Angeles, CA) American Society of Mechanical Engineers, Design and Production Engineering Technical Conference, Washington, DC, Sept 12-15, 1982, 10 p refs
(Contract NSF MEA-80-08926)
(ASME PAPER 82-DET-45)

This paper presents a method for analyzing the complete behavior of industrial robotic manipulators with complex-shape flexible links, including the effects of the manipulator's control systems and actuators The kinematics and dynamics of the manipulator are expressed in terms of 4 x 4 matrices The distributed flexibility and mass properties of the links are obtained by using readily available finite-element models and programs The resulting equations are transformed to produce a method which is computationally efficient through a procedure called Component Mode Synthesis The method is applied to an actual industrial manipulator and the results are compared to experimental data, showing good correlation Link flexibility is demonstrated to have significant impact on system performance and stability (Author)

A83-19950* Ohio State Univ, Columbus
COMPUTER COORDINATION OF LIMB MOTION FOR LOCOMOTION OF A MULTIPLE-ARMED ROBOT FOR SPACE ASSEMBLY
C A KLEIN (Ohio State University, Columbus, OH) and M R PATTERSON (Battelle Columbus Laboratories, Columbus, OH) IEEE Transactions on Systems, Man, and Cybernetics, vol SMC-12, Nov-Dec 1982, p 913-919 refs
(Contract NSF ENG-78-18957, NAG1-30)

Consideration is given to a possible robotic system for the construction of large space structures, which may be described as a multiple general purpose arm manipulator vehicle that can walk over the structure under construction to a given site for further work A description is presented of the locomotion of such a vehicle, modeling its arms in terms of a currently available industrial manipulator It is noted that for whatever maximum speed of operation is chosen, rapid changes in robot velocity create situations in which already-selected handholds are no longer practical A step is added to the 'free gait' walking algorithm in order to solve this problem O C

N83-19806*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
A MOBILE WORK STATION CONCEPT FOR MECHANICALLY AIDED ASTRONAUT ASSEMBLY OF LARGE SPACE TRUSSES
W L HEARD, JR, H G BUSH, R E WALLSON (Kentron International, Inc, Hampton, Va), and J K JENSEN (Kentron International, Inc, Hampton, Va) Mar 1983 36 p refs
(NASA-TP-2108, L-15523, NAS 1 60 2108) Avail NTIS HC A03/MF A01 CSCL 22B

This report presents results of a series of truss assembly tests conducted to evaluate a mobile work station concept intended to mechanically assist astronaut manual assembly of erectable space trusses The tests involved assembly of a tetrahedral truss beam by a pair of test subjects with and without pressure (space) suits, both in Earth gravity and in simulated zero gravity (neutral buoyancy in water) The beam was assembled from 38 identical graphite-epoxy nestable struts, 5 4 m in length with aluminum quick-attachment structural joints Struts and joints were designed to closely simulate flight hardware The assembled beam was approximately 16 5 m long and 4 5 m on each of the four sides of its diamond-shaped cross section The results show that average in-space assembly rates of approximately 38 seconds per strut can be expected for struts of comparable size This result is virtually independent of the overall size of the structure being assembled The mobile work station concept would improve astronaut efficiency for on-orbit manual assembly of truss structures, and also this assembly-line method is highly competitive with other construction methods being considered for large space structures Author

09

PROPULSION

Includes propulsion concepts and designs utilizing solar sailing, solar electric, ion, and low thrust chemical concepts

A83-11332
SPACE SAIL LINER
A V LUKIANOV (Moskovskii Gosudarstvennyi Universitet, Akademiia Nauk SSSR, Sovet Interkosmos, Moscow, USSR) (International Astronautical Federation, International Astronautical Congress on Space Mankind's Fourth Environment, 32nd, Rome, Italy, Sept 6-12, 1981) Acta Astronautica, vol 9, June-July 1982, p 359-364 refs

The feasibility of constructing solar sail-powered cargo liners to move dozens to hundreds of tons of material between locations in space is assessed A design is proposed for employing multiunit sail propulsion systems The sails, i e, reflecting units, would consist of a reflector and an orientation control device Calculations are presented of the control rope density required, the angles of orientation, and the use of either steel or thermostable graphite-polyimides for the sail material Numerical models are developed for control strategies Construction of the sails is shown to be possible with automatically manufactured truss beams, with the sails equipped with sensors and solar cells for orientation information and control It is suggested that the fabrication of a large interplanetary sailing fleet, using nonterrestrial materials, is possible M S K

A83-12460*# Hughes Research Labs, Malibu, Calif
ON-ORBIT PROPULSION REQUIREMENTS AND PERFORMANCE ASSESSMENT OF ION PROPULSION SUBSYSTEMS FOR FUTURE GEO LARGE SATELLITE MISSIONS
F J WESSEL (Hughes Research Laboratories, Malibu, CA), M E MANTENIEKS, and R S DEESPOSTI (NASA, Lewis Research Center, Cleveland, OH) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 13 p refs
(Contract NAS3-22447)
(AIAA PAPER 82-1872)

It is pointed out that a large class of future spacecraft, referred to as large space structures (LSS), will require advanced stationkeeping thrust subsystems The present investigation is concerned with the performance requirements of such advanced stationkeeping thrust subsystems An analytical model is employed to evaluate the sensitivity of the total stationkeeping thrust-system mass, for geosynchronous spacecraft, to variations in the mission parameters and thrust-system performance, taking into account ion propulsion thrust systems The model is formulated for geosynchronous missions and considers only the N-S orbit perturbations due to sun-moon forces and the E-W orbit perturbations due to solar pressure, since these are the dominant orbit perturbations of LSS missions The thrust system is scaled in relation to the performance capabilities of the existing 8- and 30-cm diameter ion-thruster technology and consists of separate N-S and E-W thrusters G R

A83-12467*# Jet Propulsion Lab, California Inst of Tech, Pasadena
MAGNETOPLASMADYNAMIC THRUSTER DEVELOPMENT
E V PAWLIK (California Institute of Technology, Jet Propulsion Laboratory, Electric Propulsion and Plasma Technology Group, Pasadena, CA) and R J VONDRA (USAF, Rocket Propulsion Laboratory, Edwards AFB, CA) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 7 p refs
(Contract NAS7-100)
(AIAA PAPER 82-1882)

Current research on self-field MPD thrusters presents the possibility of developing high power/low cost electric propulsion The interest generated in this propulsion concept within both NASA and the U S Air Force has led to a coordinated interagency effort, and the recent completion of several test sites are expected to speed thruster concept development Efficiencies approaching 40% at 2200 sec have been experimentally demonstrated Among the characteristics recommending development of MPD thrusters are high thrust density and power handling capability, simplicity, and a wide dynamic range of thrust and specific impulse MPD thrusters can, moreover, operate either continuously, at high available power levels, or in a pulsed mode, to match lower power levels O C

A83-12468#
RADIATED EMISSION NOISE OF THE PLASMA
K IJICHI, T YOSHIDA (Mitsubishi Electric Corp, Space Systems Dept, Kamakura, Kanagawa, Japan), I KUDO (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan), and K KURIKI (Tokyo, University, Tokyo, Japan) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 11 p refs
(AIAA PAPER 82-1883)

Measurement of the emission noise radiated by an MPD arcjet and an electron beam accelerator plasma in a large space chamber shows that such noise slightly exceeds current electromagnetic compatibility standards, although chamber wall reflection was incompatible with test specifications No interference is expected for the case of S band communications links, although some may appear in UHF links The Spacelab-1 Space Experiments with Particle Accelerators flight hardware employed in these tests exhibited no malfunctions O C

A83-12470#
FAST ACTING VALVE FOR A QUASI-STEADY MPD ARCJET
H SUZUKI (Ishikawajima-Harima Heavy Industry Co, Ltd, Tokyo, Japan) and K KURIKI (Tokyo, University, Tokyo, Japan) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 8 p
(AIAA PAPER 82-1886)

Quasi-steady MPD arcjet mass flow rate, cycle life, and gas pulse rise time and duration requirements are satisfied by means of a fast acting valve (FAV) FAV characteristics which have been experimentally determined include a pulse duration which is variable from 0 5 to 10 msec, 150-msec rise and fall times, and a mass flow rate of 0 1 to 10 g/sec of Ar Life cycle testing has proceeded to over one million pulses without variation in propellant gas pulse length and response No leakage has been noted It is expected that the operational temperature range of the FAV will be raised to 200 C, and that total weight will be reduced to levels acceptable for flight modelling O C

A83-12476#
A NUCLEAR POWERED PULSED INDUCTIVE PLASMA ACCELERATOR AS A VIABLE PROPULSION CONCEPT FOR ADVANCED OTV SPACE APPLICATIONS
M L TAPPER (Rockwell International Corp, Space Transportation and Systems Group, Downey, CA) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 6 p refs
(AIAA PAPER 82-1899)

An electric propulsion concept suitable for delivering heavy payloads from low earth orbit (LEO) to high energy earth orbit is proposed The system consists of a number of pulsed inductive plasma thrusters powered by a 100 kWe space nuclear power system The pulsed plasma thruster is a relatively simple electrodeless device It also exhibits adequate conversion to thrust power in the desired I sub sp regime of 1500 to 3000 seconds for optimal payload transfer from low earth to high earth orbit Because of these features and the fact that the nuclear power unit will be capable of delivering sustained high power levels throughout the duration of any given mission, the system presented appears to be a very promising propulsion candidate for advanced orbital transfer vehicle (OTV) applications An OTV, which makes use of this propulsion system and which has been designed to lift a 9000-lb payload into geosynchronous earth orbit, (GEO) is also examined (Author)

A83-12496*# Xerox Electro-Optical Systems, Pasadena, Calif
DEVELOPMENT OF A LARGE INERT GAS ION THRUSTER
G STEINER (Xerox Electro-Optical Systems, Pasadena, CA) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 7 p refs
(Contract NAS3-22444)
(AIAA PAPER 82-1927)

A 30 cm inert gas electrostatic ion thruster has been developed, exhibiting excellent performance In the development, the effective anode area was reduced by altering the magnetic field geometry to improve plasma containment, consistent with operational stability The propellant introduction scheme has the effect of 'folding' the discharge chamber without the increased wall loss penalty associated with a longer chamber These features contribute to a low discharge cost (eV/ion) versus mass utilization characteristic which remains relatively flat even to high mass utilizations (Author)

A83-16925*# National Aeronautics and Space Administration, Washington, D C
ELECTRIC PROPULSION RESEARCH AND TECHNOLOGY IN THE UNITED STATES
W R HUDSON (NASA, Washington, DC), R J VONDRA (USAF, Rocket Propulsion Laboratory, Edwards AFB, CA), T COCHRAN (NASA, Lewis Research Center, Cleveland, OH), and E PAWLIK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 14 p refs
(AIAA PAPER 82-1867)

Near-, mid-, and long-term technology goals for space electric propulsion systems are reviewed Technological readiness has been demonstrated for 8 cm, 5 mN, and 30 cm, 30 mN electrostatic thrusters, with major use seen for GEO communications satellites in the near-term, and space station orbit adjustments later Ion thrusters and/or MPD thrusters are projected to become viable if a space nuclear reactor system is operational in the 1990s, allowing the transport of thousands of kilograms to the outer planets Basic research is proceeding on the electrothermal propulsion concept to provide resistojet thrusters suitable for a space station by 1986, although the program is hindered by insufficient funding A flight test for the ion auxiliary propulsion system is detailed, and test results of the solar electric rocket (SERT II) are reported Particular note is made of the progress on the solar electric propulsion system for the Shuttle and the Nuclear electric propulsion system

for thermal-to-electric conversion for mid-1990s applications
M S K

A83-24360*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PROPULSION AND FLUID MANAGEMENT - STATION KEEPING WILL EAT ENERGY ON A NEW SCALE
D A PETRASH (NASA, Lewis Research Center, Cleveland, OH) Astronautics and Aeronautics, vol 21, Mar 1983, p 64, 65
An attempt is made to identify technologies that could be brought to a state of minimal development risk in the near term, yet offer the potential for evolutionary growth consistent with future space station propulsion requirements Prospective auxiliary propulsion propellants will be usable by other systems, thereby offering resupply benefits and a benign rather than corrosive or toxic handling environment NASA programs are currently underway to develop the storage and supply methods for cryogenic liquids in orbit The recovery of unused propellants from the Space Shuttle Orbiter and External Tank are being evaluated in order to define Shuttle modifications and performance penalties Fluid management subsystem requirements and characteristics cannot, however, be fully defined until a firm mission scenario has been established and other space station subsystems are more clearly defined O C

N83-14158*# Hughes Research Labs , Malibu, Calif
ANALYSIS AND DESIGN OF ION THRUSTER FOR LARGE SPACE SYSTEMS Final Report, 21 May 1979 - 21 May 1980
R L POESCHEL and S KAMI Sep 1980 113 p refs
(Contract NAS3-21936)
(NASA-CR-165140, NAS 1 26 165140) Avail NTIS HC A06/MF A01 CSCL 21C
Design analyses showed that an ion thruster of approximately 50 cm in diameter will be required to produce a thrust of 0 5 N using xenon or argon as propellants, and operating the thruster at a specific impulse of 3530 sec or 6076 sec respectively A multipole magnetic confinement discharge chamber was specified Author

N83-14159*# Xerox Electro-Optical Systems, Pasadena, Calif
ANALYSIS AND DESIGN OF ION THRUSTERS FOR LARGE SPACE SYSTEMS Final Report, 23 May 1979 - 23 May 1980
E L JAMES 31 Jul 1980 88 p refs
(Contract NAS3-21937)
(NASA-CR-165160, NAS 1 26 165160) Avail NTIS HC A05/MF A01 CSCL 21C
This study undertakes the analysis and conceptual design of a 0 5 Newton electrostatic ion thruster suitable for use on large space system missions in the next decade Either argon or xenon gas shall be used as propellant A 50 cm diameter discharge chamber was selected to meet stipulated performance goals The discharge plasma is contained at the boundary by a periodic structure of alternating permanent magnets generating a series of line cusps Anode strips between the magnets collect Maxwellian electrons generated by a central cathode Ion extraction utilizes either two or three grid optics at the user's choice An extensive analysis was undertaken to investigate optics behavior in the high power environment of this large thruster A plasma bridge neutralizer operating on inert gas provides charge neutralizing electrons to complete the design The resulting conceptual thruster and the necessary power management and control requirements are described Author

N83-15867*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
RADIATION-DRIVEN MHD SYSTEMS FOR SPACE APPLICATIONS Final Report
J H LEE (Vanderbilt Univ) and N W JALUFKA *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 11 p 1982 refs
Avail NTIS HC A99/MF A01
High-power radiation such as concentrated solar or high-power laser radiation is considered as a driver for magnetohydrodynamic (MHD) systems which could be developed for efficient power generation and propulsion in space Eight different systems are conceivable since the MHD systems can be classified in two plasma and liquid-metal MHD's Each of these systems is reviewed and solar- (or laser-) driven MHD thrusters are proposed Author

N83-17587*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
OPERATION OF THE J-SERIES THRUSTER USING INERT GAS
V K RAWLIN 1982 17 p refs Presented at the 16th Intern Elec Propulsion Conf , New Orleans, 17-19 Nov 1982, sponsored by AIAA, Japan Soc for Aeronautical and Space Sciences, and DGLR
(NASA-TM-82977, E-1406, NAS 1 15 82977, AIAA-PAPER-82-1929) Avail NTIS HC A02/MF A01 CSCL 21H
Electron bombardment ion thrusters using inert gases are candidates for large space systems The J-Series 30 cm diameter thruster, designed for operation up to 3 k-W with mercury, is at a state of technology readiness The characteristics of operation with xenon, krypton, and argon propellants in a J-Series thruster with that obtained with mercury are compared The performance of the discharge chamber, ion optics, and neutralizer and the overall efficiency as functions of input power and specific impulse and thruster lifetime were evaluated As expected, the discharge chamber performance with inert gases decreased with decreasing atomic mass Aspects of the J-Series thruster design which would require modification to provide operation at high power with insert gases were identified A R H

N83-21002*# Martin Marietta Aerospace, Denver, Colo
STUDY FOR ANALYSIS OF BENEFIT VERSUS COST OF LOW THRUST PROPULSION SYSTEM Final Report, Nov. 1982 - Feb. 1983
K M HAMLYN, R I ROBERTSON, and L J ROSE Mar 1983 154 p refs
(Contract NAS3-23246)
(NASA-CR-168011, NAS 1 26 168011, MCR-82-521) Avail NTIS HC A08/MF A01 CSCL 21H
The benefits and costs associated with placing large space systems (LSS) in operational orbits were investigated, and a flexible computer model for analyzing these benefits and costs was developed A mission model for LSS was identified that included both NASA/Commercial and DOD missions This model included a total of 68 STS launches for the NASA/Commercial missions and 202 launches for the DOD missions The mission catalog was of sufficient depth to define the structure type, mass and acceleration limits of each LSS Conceptual primary propulsion stages (PPS) designs for orbital transfer were developed for three low thrust LO2/LH2 engines baselined for the study The performance characteristics for each of these PPS was compared to the LSS mission catalog to create a mission capture The costs involved in placing the LSS in their operational orbits were identified The two primary costs were that of the PPS and of the STS launch The cost of the LSS was not included as it is not a function of the PPS performance The basic relationships and algorithms that could be used to describe the costs were established The benefit criteria for the mission model were also defined These included mission capture, reliability, technical risk, development time, and growth potential Rating guidelines were established for each parameter For flexibility, each parameter is assigned a weighting factor S L

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GENERAL

Includes either state-of-the-art or advanced technology which may apply to Large Space Systems and does not fit within the previous categories Publications of conferences, seminars, and workshops are covered in this area

A83-11330

SPACE: MANKIND'S FOURTH ENVIRONMENT; PROCEEDINGS OF THE THIRTY-SECOND INTERNATIONAL ASTRONAUTICAL CONGRESS, ROME, ITALY, SEPTEMBER 6-12, 1981

L G NAPOLITANO, (ED) (Napoli, Universita, Naples, Italy) Congress sponsored by the International Astronautical Federation Acta Astronautica, vol 9, June-July 1982 149 p

Consideration is given to various topics of earth-oriented space activities The missions of the first Spacelab and of the Shuttle tethered satellite concept are discussed, together with metabolic changes in animals during space flight and medication to eliminate space sickness among humans during space flight Applications of elevation models for landform analysis using Seasat-SAR imagery are explored, as are the electromagnetic environment surrounding the Intercosmos-Bulgaria 1300 satellite and the stability of eccentric polar orbits around the moon Analyses are presented of long term projects such as a baseline system for lunar manufacturing, control problems in large space structures, and the development of composite materials and geodetic structures for space systems Finally, a convective model for Jupiter is developed M S K

A83-11926

SPACELAB, SPACE PLATFORMS AND THE FUTURE; PROCEEDINGS OF THE FOURTH JOINT AAS/DGLR SYMPOSIUM AND TWENTIETH GODDARD MEMORIAL SYMPOSIUM, WASHINGTON, DC, MARCH 17-19, 1982

P M BAINUM, (ED) (Howard University, Washington, DC) and D E KOELLE (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Symposium sponsored by AAS, DGLR, AIAA, et al San Diego, CA, Univelt, Inc , 1982 501 p $43 25

National and international program goals for the next generation of civil space missions are discussed Attention was given to the instrumentation and hardware intended for the Spacelab flights, with specific details of material processing, remote sensing, life sciences, astrophysical, and solar physics experiments Free-flying space platforms to be launched, serviced, and/or retrieved by the Shuttle are described, together with mission requirements attesting to the need for a permanently manned space station and also constraining its design Earth-oriented space activities were surveyed, including microwave remote sensing apparatus for the Shuttle and autonomous satellites, data processing systems for earth resources satellites, and solid-state instrumentation concepts NASA and ESA launch vehicles in the near term are projected, and the history of manned maneuvering units is traced M S K

A83-12732*

ADVANCES AND TRENDS IN STRUCTURAL AND SOLID MECHANICS; PROCEEDINGS OF THE SYMPOSIUM, WASHINGTON, DC, OCTOBER 4-7, 1982

A K NOOR, (ED) (George Washington University, Hampton, VA) and J M HOUSNER (NASA, Langley Research Center, Structures and Dynamics Div , Hampton, VA) Symposium sponsored by the George Washington University and NASA Computers and Structures, vol 16, no 1-4, 1983 595 p

The mechanics of materials and material characterization are considered, taking into account micromechanics, the behavior of steel structures at elevated temperatures, and an anisotropic plasticity model for inelastic multiaxial cyclic deformation Other topics explored are related to advances and trends in finite element technology, classical analytical techniques and their computer implementation, interactive computing and computational strategies for nonlinear problems, advances and trends in numerical analysis, database management systems and CAD/CAM, space structures and vehicle crashworthiness, beams, plates and fibrous composite structures, design-oriented analysis, artificial intelligence and optimization, contact problems, random waves, and lifetime prediction Earthquake-resistant structures and other advanced structural applications are also discussed, giving attention to cumulative damage in steel structures subjected to earthquake ground motions, and a mixed domain analysis of nuclear containment structures using impulse functions G R

A83-15655

INTERNATIONAL SCIENTIFIC CONFERENCE ON SPACE, 22ND, ROME, ITALY, MARCH 25, 26, 1982, PROCEEDINGS [CONVEGNO INTERNAZIONALE SCIENTIFICO SULLO SPAZIO, 22ND, ROME, ITALY, MARCH 25, 26, 1982, ATTI]

Conference sponsored by the Ministero degli Affari Esteri, CNR, ESA, et al Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1982 330 p In Italian, English, and French

Ongoing, developmental, and prospective future NASA and ESA space programs are discussed Progress toward operational status of the STS is reviewed, as are NASA efforts on the Galileo probe, the launch of the ISPM, and the construction of the Vandenberg space facility Details of existing and planned ESA communications and science spacecraft are outlined, noting completion of aircraft flights to test the design of the SAR for the ERS-1 satellite Attention is given to indigenous Swedish programs for producing their own telephony and direct broadcast spacecraft, and to Italian participation in the L-Sat program The work on the German/Italian/U S San Marco D/1 spacecraft is reviewed, and program goals for the French projects for realization in the 1990-2000 timeframe are summarized Potential impacts of space industrialization on developing and industrialized nations are examined, along with planned and operational international and national communications satellite systems M S K

A83-15806

ADVANCES IN DETECTORS FOR ASTRONOMICAL SPECTROSCOPY

A BOKSENBERG (Royal Greenwich Observatory, Herstmonceux, Sussex, England) (Royal Society, Discussion on New Techniques in Optical and Infrared Spectroscopy, London, England, Apr 21, 22, 1982) Royal Society (London), Philosophical Transactions, Series A, vol 307, no 1500, Nov 12, 1982, p 531-548 refs

It is pointed out that spectroscopy is the most important investigative technique applied in astronomy In many respects it is far more challenging to find appropriate image-reproducing detectors for astronomical spectroscopy than for direct-imaging applications A functional tree is presented to show the operation of various practical imaging detectors in current or planned use A clear trend in the use of detectors in astronomy in recent years has been the increased application of electronic data processing and computer techniques An account is given of some of the techniques implied in the functional tree, taking into account detectors suitable for astronomical applications in the ultraviolet, optical, and near infrared (to about 1 micrometer) spectral ranges Attention is given to photographic emulsions, electronography, image intensifiers, integrating television camera tubes, image photon-counting systems, and solid-state detectors G R

A83-21392

NGOS AT UNISPACE 82

D C WEBB Journal of Space Law, vol 10, Fall 1982, p 195-198

Topics discussed at a nongovernmental organizations (NGO) segment of the UNISPACE 82 conference are summarized Spanning ten days and the presentation of more than 120 speeches, the NGO conference covered such topics as the impact of space on development, the environmental aspects of space, energy from space, private involvement in space activities, the maintenance of peace in space, and the implications of space technologies on bioresources Continued studies of solar power satellite systems were favorably discussed, as were private ownership of a Shuttle and operation of a privately owned satellite launch service, which is expected to decrease the costs of placing earth resources satellites in orbit Opposition to the deployment of weaponry in space was expressed The effectiveness of the ducational ATS-6 satellite in India was described, together with international student trips to the Johnson Space Center for an introduction to space technology Finally, the philosophical aspects of the impacts of space developments on human life were explored D H K

A83-23601

MATERIAL AND PROCESS ADVANCES '82; PROCEEDINGS OF THE FOURTEENTH NATIONAL SAMPE TECHNICAL CONFERENCE, ATLANTA, GA, OCTOBER 12-14, 1982

Conference sponsored by the Society for the Advancement of Material and Process Engineering Azusa, CA, Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series Volume 14), 1982 584 p

Among the topics discussed in the present conference, which assesses advancements in a variety of state-of-the-art materials technologies, are solvent-insensitive graphite-reinforced thermoplastic composites, the use of fine metal fibers as engineering materials, the uses of sealants in composite structures, electronics encapsulation materials, the use of silicone sealants as adhesives, weak boundary zones in metal bonds, and the performance of Space Shuttle Orbiter graphite/epoxy and graphite/polyimide composites Also discussed are aerospace industry drilling technology developments, Celion graphite fibers, graphite/epoxy composite aerospace structures applications and nondestructive evaluation, and the UV curing of cycloaliphatic epoxide coatings O C

A83-24701

CONFERENCE ON DECISION AND CONTROL, 20TH, AND SYMPOSIUM ON ADAPTIVE PROCESSES, SAN DIEGO, CA, DECEMBER 16-18, 1981, PROCEEDINGS. VOLUMES 1, 2 & 3

Conference and Symposium sponsored by the Institute of Electrical and Electronics Engineers New York, Institute of Electrical and Electronics Engineers, 1981 Vol 1, 532 p, vol 2, 484 p, vol 3, 659 p

Topics discussed include the theory and application of adaptive signal-processing techniques, current problems in filtering and stochastic control, identification and control in biomedical systems, asymptotic approaches in dynamic systems, and identification and control of distributed-parameter systems Attention is also given to approximation methods for nonlinear estimation, to fast algorithms and image processing, to control problems in computer communication networks, and to software for modeling and control system design Papers are presented on optimization and stability methods in power systems, on the selection of measurements and controls in large-scale systems, on functional integration and applications in control and filtering, and on the management and control of manufacturing systems Other topics are a practical benchmark example for adaptive control, nonlinear filtering and detection, methods for dynamic economic analysis, and new techniques in the synthesis of feedback control systems C R

A83-26577

CONTROL SCIENCE AND TECHNOLOGY FOR THE PROGRESS OF SOCIETY; PROCEEDINGS OF THE EIGHTH TRIENNIAL WORLD CONGRESS, KYOTO, JAPAN, AUGUST 24-28, 1981. VOLUME 4 PART A - MECHANICAL SYSTEMS AND ROBOTS. PART B - AEROSPACE AND TRANSPORTATION

H AKASHI, (ED) (Kyoto University, Kyoto, Japan) Congress sponsored by the International Federation of Automatic Control Oxford, Pergamon Press, 1982 685 p

Topics discussed include satellite attitude control using momentum wheels, a sensitivity analysis of a modal controller for flexible space structures, the design of an ion thruster system for satellite position control, the implementation of operational aspects in the European Spacelab System, software for the automatic control of spacecraft instruments, and the development of adaptation and identification algorithms in adaptive digital aircraft control systems Also examined are altitude transitions in energy climbs, control and design aspects of magnetically suspended vehicles, the dynamics and control of maglev vehicles with parameter uncertainties, feedback laws for robotic systems, a CAD/CAM application for wheelchair analysis, a microprocessor-based power measurement device for control applications, and an electromagnetic damper for the vibration control of a transmission shaft Several case studies are also presented including the development of an attitude stabilization and control system of a Japanese scientific satellite, the attitude and orbit control system of the MOS-1, the application of redundant processing to the Space Shuttle, and the results of a world survey of computer-aided manufacturing N B

A83-27126

IECEC '82; PROCEEDINGS OF THE SEVENTEENTH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, LOS ANGELES, CA, AUGUST 8-12, 1982. VOLUMES 1, 2, 3, 4 & 5

Conference sponsored by IEEE, ACS, AIChE, AIAA, ANS, ASME, and SAE New York, Institute of Electrical and Electronics Engineers, 1982 Vol 1, 534 p, vol 2, 639 p, vol 3, 565 p, vol 4, 499 p, vol 5, 502 p

A comprehensive assessment of advanced energy conversion technologies is presented, including experimental, conventional, and developmental systems, and systems entering into wide-scale use Attention is given to pyroelectric, gas-cooled nuclear reactor, and delta-wing ventilator concepts, and to space power systems Biomass conversion technologies are examined, as are progress on electric vehicles, improvements in energy use efficiency, and evolving energy policy Electrochemical and fossil fuel systems are studied, and geothermal energy, hydrogen fuels, and MHD systems are discussed Consideration is directed toward nuclear, ocean thermal, and wave energy devices The state of the art in Stirling engines, solar electric and thermal energy conversion systems, and thermionics is explored Finally, consideration is given to thermal/wind energy storage and electrical and mechanical energy producing wind-powered machines D H K

A83-27326*# National Aeronautics and Space Administration, Washington, D C

THE NASA PROGRAM IN SPACE ENERGY CONVERSION RESEARCH AND TECHNOLOGY

J P MULLIN, D J FLOOD, J H AMBRUS, and W R HUDSON (NASA, Washington, DC) In IECEC '82, Proceedings of the Seventeenth Intersociety Energy Conversion Engineering Conference, Los Angeles, CA, August 8-12, 1982 Volume 5 New York, Institute of Electrical and Electronics Engineers, 1982, p 2150-2162

The considered Space Energy Conversion Program seeks advancement of basic understanding of energy conversion processes and improvement of component technologies, always in the context of the entire power subsystem Activities in the program are divided among the traditional disciplines of photovoltaics, electrochemistry, thermoelectrics, and power systems management and distribution In addition, a broad range of cross-disciplinary explorations of potentially revolutionary new concepts are supported under the advanced energetics program area Solar cell research and technology are discussed, taking into account the enhancement of the efficiency of Si solar cells, GaAs liquid phase epitaxy and vapor phase epitaxy solar cells, the use of GaAs solar cells in concentrator systems, and the efficiency of a three junction cascade solar cell Attention is also given to blanket and array technology, the alkali metal thermoelectric converter, a fuel cell/electrolysis system, and thermal to electric conversion G R

A83-27426
1982 ADVANCES IN AEROSPACE STRUCTURES AND MATERIALS; PROCEEDINGS OF THE WINTER ANNUAL MEETING, PHOENIX, AZ, NOVEMBER 14-19, 1982
R M LAURENSON, (ED) (McDonnell Douglas Astronautics Co , St Louis, MO) and U YUCEOGLU (Florida International University, Miami, FL) Meeting sponsored by the American Society of Mechanical Engineers New York, American Society of Mechanical Engineers , 1982 145 p

Papers are presented covering research in the fracture mechanics, fatigue, dynamic response, adhesive joints, and viscoelastic behavior of composite structures, new developments in analytical and finite element techniques, and flaw and fracture analysis Topics discussed include the viscoelastic effects on the buckling of laminated plates subjected to hygrothermal conditions, a finite element method for the construction of dynamical theories of layered plates, the analysis of adhesive joints in fiber-reinforced composite plates and shells, and the contact between a rigid cylinder and an orthotropic beam under initial stress Also examined are a theory for transverse cracks in composite laminates, the measurement of local stress distributions in damaged composites using an electric analog, the vibration of sandwich beams with bimodular facings, the thermal deformations of graphite expoxy, and the general relations for exact and inexact involute bodies of revolution N B

A83-29729
STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 24TH, LAKE TAHOE, NV, MAY 2-4, 1983, COLLECTION OF TECHNICAL PAPERS. PART 1 - STRUCTURES AND MATERIALS. PART 2 - STRUCTURAL DYNAMICS
Conference sponsored by AIAA, ASME, ASCE, and AHS New York, American Institute of Aeronautics and Astronautics, 1983 Pt 1, 750 p, pt 2, 791 p

Among the topics covered are the analysis of large antenna spacecraft, failure problems in unidirectional fiber-reinforced composites, the fracture behavior of hybrid composite laminates, the structural tailoring of engine blades, structural optimization by multilevel decomposition, dynamic crack propagation analysis, the finite deformation analysis of shells, damage tolerance analysis, beryllium structures, delamination buckling, the optimization of bonded joints, carbon-carbon composites, minimum weight design of structures, silicon nitride, and an algorithm for design synthesis Also discussed are cast titanium inlet ducts, static and damage tolerance testing of a composite vertical fin, acoustic fatigue prevention, the mechanical properties of superplastically formed core materials, Ti powder metallurgy components, and finite element techniques for plate structures Author

N83-12147*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ADVANCED MATERIALS TECHNOLOGY
C P BLANKENSHIP, comp and L A TEICHMAN, comp Nov 1982 438 p refs Proc held at Hampton, Va , 16-17 Nov 1982 Sponsored in cooperation with AIAA
(NASA-CP-2251, L-15537, NAS 1 55 2251) Avail NTIS HC A19/MF A01 CSCL 11G

Composites, polymer science, metallic materials (aluminum, titanium, and superalloys), materials processing technology, materials durability in the aerospace environment, ceramics, fatigue and fracture mechanics, tribology, and nondestructive evaluation (NDE) are discussed Research and development activities are introduced to the nonaerospace industry In order to provide a convenient means to help transfer aerospace technology to the commercial mainstream in a systematic manner

N83-13130*# National Aeronautics and Space Administration, Washington, D C
SPACE RESEARCH AND TECHNOLOGY PROGRAM: PROGRAM AND SPECIFIC OBJECTIVES, DOCUMENT APPROVAL
13 Jun 1982 177 p
(NASA-TM-85162, NAS 1 15 85162) Avail NTIS HC A09/MF A01 CSCL 22A

A detailed view of the Space Research and Technology program work breakdown structure is provided down to the specific objective level Goals or objectivs at each of these levels are set forth The specific objective narratives are structured into several parts First, a short paragraph statement of the specific objective is given This is followed by a list of subobjectives A list of targets is then provided for those areas of the specific objective that are amenable to a quantitative description of technical accomplishment and schedule Fluid and thermal physics, materials and structures, computer science and electronics, space energy conversion, multidisciplinary research, controls and human factors, chemical propulsion, spacecraft systems, transportation systems, platform systems, and spacecraft systems technology comprise the principal research programs N W

N83-14694# European Space Agency, Paris (France)
PHOTOVOLTAIC GENERATORS IN SPACE
W R BURKE, comp Jun 1982 331 p refs Partly in ENGLISH and FRENCH Proc of 3rd European Symp Bath, England, 4-6 May 1982, sponsored in cooperation with UK Dept of Industry and RAE
(ESA-SP-173, ISSN-0379-6566) Avail NTIS HC A15/MF A01

Solar array design and testing were discussed Radiation damage, blankets, solar cells, and the status of NASA and ESA spacecraft solar energy development programs were considered

N83-15168*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
RESEARCH AND TECHNOLOGY, FISCAL YEAR 1982 Annual Report, 1982
Nov 1982 86 p refs
(NASA-TM-82506, NAS 1 15 82506) Avail NTIS HC A05/MF A01 CSCL 05B

Advanced studies are reviewed Atmospheric sciences, magnetospheric physics, solar physics, gravitational physics, astronomy, and materials processing in space comprise the research programs Large space systems, propulsion technology, materials and processes, electrical/electronic systems, data bases/design criteria, and facilities development comprise the technology development activities N W

N83-15169*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
RESEARCH AND TECHNOLOGY, LEWIS RESEARCH CENTER Annual Report, 1982
1982 47 p refs
(NASA-TM-83038, NAS 1 15 83038) Avail NTIS HC A03/MF A01 CSCL 05B

Aeronautics, space, and terrestrial energy research is covered Energy conversion processes and systems for propulsion in the atmosphere, in space, and on the ground are reviewed Electric energy generation and storage for both terrestrial and space applications and materials and structures for such systems are also reviewed N W

N83-15248*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
RESEARCH AND TECHNOLOGY REPORT OF THE LANGLEY RESEARCH CENTER Annual Report
1982 91 p
(NASA-TM-84570, NAS 1 15 84570) Avail NTIS HC A05/MF A01 CSCL 05B

Highlights of major accomplishments and applications made during the past year at the Langley Research Center are reported The activities and the contributions of this work toward maintaining

United States leadership in aeronautics and space research are also discussed Accomplishments in the fields of aeronautics and space technology, space science and applications and space transportation systems are discussed E A K

N83-15323* National Aeronautics and Space Administration, Washington, D C
TECHNOLOGY FOR LARGE SPACE SYSTEMS: A SPECIAL BIBLIOGRAPHY
Jan 1982 69 p
(NASA-SP-7046(06), NAS 1 21 7046(46)) Avail NTIS HC $9 00 CSCL 22A

This bibliography lists 220 reports, articles and other documents introduced into the NASA scientific and technical information system between July 1, 1981 and December 31, 1981 Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design in the area of the Large Space Systems Technology (LSST) Program Subject matter is grouped according to systems, interactive analysis and design, structural concepts, control systems, electronics, advanced materials, assembly concepts, propulsion, solar power satellite systems, and flight experiments Author

N83-15348*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
ADVANCED AUTOMATION FOR SPACE MISSIONS Final Report
R A FREITAS, JR , ed (Santa Clara Univ) and W P GILBREATH, ed Nov 1982 392 p refs Meeting held in Santa Clara, Calif , 23 Jun - 29 Aug 1980, sponsored in cooperation with Am Soc for Eng Education Original contains color illustrations
(NASA-CP-2255, A-8618, NAS 1 55 2255) Avail NTIS HC A17/MF A01 CSCL 22B

The feasibility of using machine intelligence, including automation and robotics, in future space missions was studied

N83-15806*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
SPACE PHOTOVOLTAIC RESEARCH AND TECHNOLOGY 1982 HIGH EFFICIENCY, RADIATION DAMAGE, AND BLANKET TECHNOLOGY
Washington 1982 263 p refs Conf held in Cleveland, 20-22 Apr 1982
(NASA-CP-2256, E-1303, NAS 1 55 2256) Avail NTIS HC A12/MF A01 CSCL 10A

Space solar cell reseach and development issues are addressed

N83-15841# R and D Associates, Rosslyn, Va
PROCEEDINGS OF THE AFOSR SPECIAL CONFERENCE ON PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS, VOLUME 1 Final Report
P J TURCHI 1982 767 p refs Conf held in Norfolk, Va , 22-25 Feb 1982 2 Vol
(Contract F49620-82-C-0008)
(AD-A118887, AFOSR-82-0655TR-VOL-1) Avail NTIS HC A99/MF A01 CSCL 10B

State-of-the-art space prime-power technology is reviewed Research needs for progress toward megawatt power levels are discussed Chemical, nuclear, and radiant energy techniques, power conversion, heat rejection, materials, chemical and fluid physics are discussed

N83-15860# R and D Associates, Rosslyn, Va
PROCEEDINGS OF THE AFOSR SPECIAL CONFERENCE ON PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS, VOLUME 2 Final Report
P J TURCHI 1982 834 p refs Conf held in Norfolk, Va , 22-25 Feb 1982 2 Vol
(Contract F49620-82-C-0008)
(AD-A118888, AFOSR-82-0656TR-VOL-2) Avail NTIS HC A99/MF A01 CSCL 10B

The state of the art of space prime power technology is reviewed and research needed for progress toward megawatt power levels is discussed Radiant energy techniques, materials requirements, chemical physics, thermionics, thermal management systems, and power requirements of future NASA and DOE system are addressed

N83-16374# European Space Agency, Paris (France)
EUROPE'S PLACE IN SPACE
Jan 1982 48 p Original contains color illustrations
Avail NTIS HC A03/MF A01

The ESA administrative structure is outlined, and the COS B, Geos, ISEE, Exosat, Hipparcos, Giotto, ISPM, and Space Telescope programs are described The Meteosat, Sirio, LANDSAT, OTS, ECS, Marecs, L-Sat, Spacelab and Ariane programs are summarized Author (ESA)

N83-18615# Centre National d'Etudes Spatiales, Toulouse (France)
FRENCH SPACE PROGRAMS [PROGRAMME SPATIAL FRANCAIS]
1982 220 p refs in FRENCH, ENGISH summary Presented at 24th COSPAR Plenary Meeting, Ottawa 17 May - 2 Jun 1982 Prepared in cooperation with Comite National Francais de Recherche dans l'Espace
Avail NTIS HC A10/MF A01

Various activities of French space programs are discussed Astronomy, solar physics, Earth resources, geodesy, Earth atmosphere, and the solar system are among the topics discussed R J F

N83-18819*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
MODELING, ANALYSIS, AND OPTIMIZATION ISSUES FOR LARGE SPACE STRUCTURES
L D PINSON, comp , A K AMOS, comp (AFOSR, Bolling AFB, Washington, D C), and V B VENKAYYA, comp (AFWAL, Wright Patterson AFB, Ohio) Feb 1983 222 p refs Proc of workshop held in Williamsburg, Va , 13-14 May 1982
(NASA-CP-2258, NAS 1 55 2258, L-15564) Avail NTIS HC A10/MF A01

Topics concerning the modeling, analysis, and optimization of large space structures are discussed including structure-control interaction, structural and structural dynamics modeling, thermal analysis, testing, and design

N83-19639# National Science Foundation, Washington, D C Communications Program
THE 5-YEAR OUTLOOK ON SCIENCE AND TECHNOLOGY, 1981. VOLUME 2: SOURCE MATERIALS
1982 458 p refs 3 Vol
(PB82-249087, NSF/PRM-82003, NSF-81-42) Avail NTIS HC A20/MF A01 CSCL 05A

National security, space, health, energy, science and technology, natural resources, environment, transportation, agriculture, education, and international affairs are discussed Public policy problems associated with science and technology and developments in social and behavioral science disciplines are included GRA

N83-20982# European Space Agency, Paris (France) International Relations Service
SPACE SCIENCE AND TECHNOLOGY IN EUROPE TODAY
T D GUYENNE, ed and B BATTRICK, ed Jun 1982 108 p
Presented at 2nd UN Conf on Space UNISPACE-82, Vienna, 9-21 Aug 1982 Original contains color illustrations
(ESA-BR-07, ISSN-0250-1589) Avail NTIS HC A06/MF A01, ESA, Paris FF80 (EEC) FF 90 (for others)

Europe's achievements in space are described The position in the fields of space science, space applications and launch capabilities, both within Europe and outside, particularly in developing countries are noted Prospects for Europe and the developing countries are discussed A review of the programs undertaken within ESA and by the specialized national agencies is presented S L

N83-21006# European Space Agency, Paris (France)
FOURTH ESTEC SPACECRAFT POWER-CONDITIONING SEMINAR
B BATTRICK, comp and E ROLFE, comp Sep 1982 192 p refs Proc of Intern Sem , Noorwijk, Netherlands, 9-11 Nov 1982 Partly in ENGLISH and FRENCH
(ESA-SP-186, ISSN-0379-6566) Avail NTIS HC A09/MF A01

Payload and system interfaces, original regulator/converter concepts, application of new techniques/technologies, power conditioning, energy storage and auxiliary electronics, and analysis and modelling are discussed

N83-22034# European Space Agency, Paris (France) Space Science Dept
THE SCIENTIFIC IMPORTANCE OF SUBMILLIMETRE OBSERVATIONS
T DEGRAAUW, comp and T D GUYENNE, comp Aug 1982 237 p refs Proc of Workshop, Noordwijkerhout, Netherland, 10-12 May 1982
(ESA-SP-189, ISSN-0379-6566) Avail NTIS HC A11/MF A01

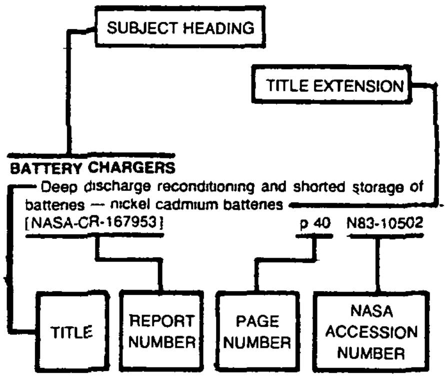
Advances in the planning and construction of mm and submm wave telescope facilities and considerations on the feasibility of submm space borne observatories needed to overcome the serious limitations imposed by the Earth's atmosphere are addressed High frequency transitions, cloud models, continuum-solar system, and instrumentation are among the topics discussed

N83-22256*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
STRUCTURAL DYNAMICS AND CONTROL OF LARGE SPACE STRUCTURES, 1982
M L BRUMFIELD, comp Washington Apr 1983 261 p refs Workshop held in Hampton, Va , 21-22 Jan 1982
(NASA-CP-2266, L-15579, NAS 1 55 2266) Avail NTIS HC A12/MF A01 CSCL 22B

Basic research in the control of large space structures is discussed Active damping and control of flexible beams, active stabilization of flexible antenna feed towers, spacecraft docking, and robust pointing control of large space platform payloads are among the topics discussed R J F

SUBJECT INDEX

Typical Subject Index Listing



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A

SUBJECT

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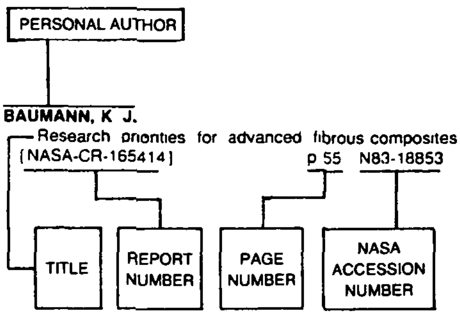
Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author The title of the document provides the user with a brief description of the subject matter The report number helps to indicate the type of document listed (e g , NASA report, translation, NASA contractor report) The page and accession numbers are located beneath and to the right of the title Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first

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Typical Corporate Source Index Listing

CORPORATE SOURCE

Air Force Geophysics Lab., Hanscom AFB, Mass.
High-level spacecraft charging environments near geosynchronous orbit
[AD-A118791] p 40 N83-12130

TITLE — REPORT NUMBER — PAGE NUMBER — NASA ACCESSION NUMBER

Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

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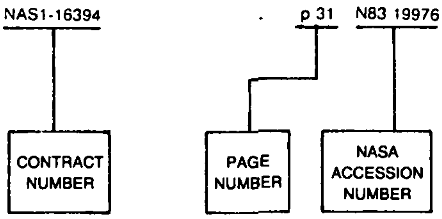
CONTRACT NUMBER INDEX

TECHNOLOGY FOR LARGE SPACE SYSTEMS / *A Bibliography (Supplement 9)* JULY 1983

Typical Contract Number Index Listing

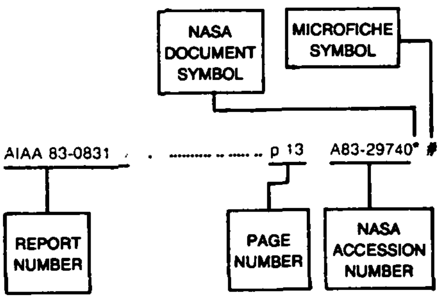


Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

CONTRACT

REPORT NUMBER INDEX

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number The page number indicates the page on which the citation is located The accession number denotes the number by which the citation is identified An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche

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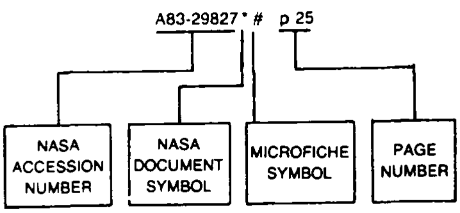
ACCESSION NUMBER INDEX

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number The page number listed to the right indicates the page on which the citation is located An asterisk (*) indicates that the item is a NASA report A pound sign (#) indicates that the item is available on microfiche

1. Report No	2 Government Accession No.	3 Recipient's Catalog No
NASA SP-7046(09)		
4 Title and Subtitle TECHNOLOGY FOR LARGE SPACE SYSTEMS A Bibliography with Indexes		5 Report Date July 1983
		6 Performing Organization Code
7. Author(s)		8 Performing Organization Report No
		10 Work Unit No
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		11 Contract or Grant No
		13 Type of Report and Period Covered
12. Sponsoring Agency Name and Address		14 Sponsoring Agency Code

15. Supplementary Notes

Report prepared, in part, by personnel in the Space Technology Flight Experiments Office and the Technical Library Branch, Hampton, Virginia.

16. Abstract

This bibliography lists 414 reports, articles and other documents introduced into the NASA scientific and technical information system between January 1, 1983 and June 30, 1983. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design in the area of Large Space System Technology. Subject matter is grouped according to systems, interactive analysis and design, structual and thermal analysis and design, structural concepts and control systems, electronics. advanced materials, assembly concepts, propulsion, and solar power satellite systems.

17 Key Words (Suggested by Author(s))	18 Distribution Statement
Large Space Systems Large Space Structures Large Space Antenna	Unclassified - Unlimited

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