



**Aerospace Medicine
and Biology**
A Continuing
Bibliography
with Indexes

NASA SP-7011(320)
February 1989

National Aeronautics and
Space Administration

A Continuing Bibliography with Indexes

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February 1989

Aerospace Medicine & Biology

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series) N89-10001 — N89-11688

IAA (A-10000 Series) A89-10001 — A89-12760

AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 320)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1989 in

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



National Aeronautics and Space Administration
Office of Management
Scientific and Technical Information Division
Washington, DC

1989

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A04.

INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 125 reports, articles and other documents announced during January 1989 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

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

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

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

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1989 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED

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ON MICROFICHE

ACCESSION NUMBER → **N89-11384*** # Houston Univ., Tex. Dept. of Biology. ← CORPORATE SOURCE

TITLE → **GROWTH OF PLANT TISSUE CULTURES IN SIMULATED LUNAR SOIL: IMPLICATIONS FOR A LUNAR BASE CELSS (CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM) Final Report, 1 Feb. 1987 - 31 Jul. 1988**

AUTHOR → **S. VENKETESWARAN** 1988 65 p

REPORT NUMBERS → (Contract NAG9-214) (NASA-CR-183233; NAS 1.26:183233) Avail: NTIS HC A04/MF ← PUBLICATION DATE

COSATI CODE → A01 CSCL 06C ← PRICE CODE

AVAILABILITY SOURCE

Experiments were carried out on plant tissue cultures, seed germination, seedling development and plants grown on Simulated Lunar Soil to evaluate the potential of future development of lunar based agriculture. The studies done to determine the effect of the placement of SLS on tissue cultures showed no adverse effect of SLS on tissue cultures. Although statistically insignificant, SLS in suspension showed a comparatively higher growth rate. Observations indicate the SLS, itself cannot support calli growth but was able to show a positive effect on growth rate of calli when supplemented with MS salts. This positive effect related to nutritive value of the SLS was found to have improved at high pH levels, than at the recommended low pH levels for standard media. Results from seed germination indicated that there is neither inhibitory, toxicity nor stimulatory effect of SLS, even though SLS contains high amounts of aluminum compounds compared to earth soil. Analysis of seedling development and growth data showed significant reduction in growth rate indicating that, SLS was a poor growth medium for plant life. This was confirmed by the studies done with embryos and direct plant growth on SLS. Further observations attributed this poor quality of SLS is due to it's lack of essential mineral elements needed for plant growth. By changing the pH of the soil, to more basic conditions, the quality of SLS for plant growth could be improved up to a significant level. Also it was found that the quality of SLS could be improved by almost twice, by external supply of major mineral elements, directly to SLS.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER → **A89-11286*** Maryland Univ., Baltimore.

TITLE → **PROGRAMMED ENVIRONMENT MANAGEMENT OF CONFINED MICROSOCIETIES** ← AUTHOR'S AFFILIATION

AUTHOR → **HENRY H. EMURIAN** (Maryland, University, Baltimore) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 976-980. refs

JOURNAL TITLE →

PUBLICATION DATE → (Contract NGR-21-001-111; N00014-80-C-0467)

A programmed environment is described that assists the implementation and management of schedules governing access to all resources and information potentially available to members of a confined microsociey. Living and work schedules are presented that were designed to build individual and group performance repertoires in support of study objectives and sustained adaptation by participants. A variety of measurement requirements can be programmed and standardized to assure continuous assessment of the status and health of a confined microsociey.

Author

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 320)

FEBRUARY 1989

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LIFE SCIENCES (GENERAL)

A89-10749

THE ROLE OF THE PARAVENTRICULAR HYPOTHALAMIC NUCLEI IN THE REACTIONS OF THE HYPOPHYSEADRENOCORTICAL SYSTEM DURING ADAPTATION TO COLD [ROL' PARAVENTRIKULIARNYKH IADER GIPOTALAMUSA V REAKTSIIAKH GIPOFIZARNO-ADRENOKORTIKAL'NOI SISTEMY PRI KHOLODOVOI ADAPTATSII]

N. K. KORMILITSYNA (Ivanovskii Gosudarstvennyi Universitet, Ivanovo, USSR) *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 74, July 1988, p. 933-937. In Russian. refs

A89-10750

OXYGENATION OF LUNG BLOOD AND THE CHARACTERISTICS OF THE HYPOXIC STATE DEVELOPMENT IN THE COURSE OF HYPERTHERMIA [OKSIGENATSIIA KROVI V LEGKIKH I OSOBENNOSTI RAZVITIIA GIPOKSICHESKOGO SOSTOIANIYA PRI GIPERTERMII]

M. M. SEREDENKO, A. A. MOIBENKO, T. D. MINAILENKO, V. P. POZHAROV, L. A. GRABOVSKII (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR) et al. *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 74, July 1988, p. 987-994. In Russian. refs

A89-11349

BIOLOGY IN SPACE

D. A. M. MESLAND (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) IN: *Microgravity research - Status and prospects; Proceedings of the SRON Symposium, Utrecht, Netherlands, Apr. 2, 3, 1987. Utrecht, Space Research Organization Netherlands, 1987, p. 119-133. refs*

Experiments that can only be performed in a Spacelab environment due to requirements for long experiment durations and the availability of on-board 1 g control centrifuges are outlined. Relevant experiments that can be performed on short-duration rocket flights are also identified. Consideration is given to those aspects of the cell that are supposed to be subject to change in a changing gravitational field, namely cellular architecture, cellular transport mechanisms, and cellular steady-state dynamic systems. It is found that microgravity increases cell proliferation in bacteria and unicellular organisms and inhibits activation of human lymphocytes. K.K.

A89-11350

LIFE SCIENCES AND MICROGRAVITY

W. J. OOSTERVELD (Academisch Medisch Centrum, Amsterdam, Netherlands) IN: *Microgravity research - Status and prospects; Proceedings of the SRON Symposium, Utrecht, Netherlands, Apr. 2, 3, 1987. Utrecht, Space Research Organization Netherlands, 1987, p. 135-143.*

The paper discusses the biological effects of microgravity on the cardiovascular and vestibular systems. The main biological problems of spaceflight are puffy faces and 'chicken legs',

cardiovascular decompensation, loss of minerals from bones, and problems involving the balance organ in the inner ear. It is found that, by decreasing the role of the otolithic apparatus, weightlessness exaggerates the importance of the other systems such as vision, which also contribute to the equilibrium function. K.K.

A89-12198

THE FUNCTIONAL LOGIC OF CORTICAL CONNECTIONS

S. ZEKL and S. SHIPP (University College, London, England) *Nature* (ISSN 0028-0836), vol. 335, Sept. 22, 1988, p. 311-317. Research supported by the Wellcome Trust and SERC. refs

The different strategies by which the visual cortex achieves both segregation and integration of features of the visual image are surveyed. The developmental segregation and specialization of the visual system is reviewed, and the separation of motion, form, and color by that system is discussed. The anatomy of segregation is examined, and the integration of visual information through convergence and through multiple stages in the visual cortex is addressed. Topical and confluent convergence are defined, the first operating within a specialized pathway and involving integration across space, the second operating between pathways and involving integration between different attributes. Some principles regarding the functional logic of cortical connections are derived, and predictions are made about the general functional organization of uncharted areas. C.D.

A89-12623* Arizona Univ., Tucson.

TIME COURSE OF THE RESPONSE OF CARBOHYDRATE METABOLISM TO UNLOADING OF THE SOLEUS

ERIK J. HENRIKSEN and MARC E. TISCHLER (Arizona, University, Tucson) *Metabolism* (ISSN 0026-0495), vol. 37, March 1988, p. 201-208. refs

(Contract NAGW-227; NAG2-384)

The time course of the response of carbohydrate metabolism to unloading was studied in the soleus muscle of rats subjected to tail-cast suspension. In the fresh soleus, 12 hours of unloading led to higher concentrations of glycogen and lower activity ratios of both glycogen synthase and glycogen phosphorylase. These changes were still evident on day three. Thereafter, the increased glycogen concentration apparently diminished the activity ratio of glycogen synthase, leading to a subsequent fall in the total glycogen content after day one. After 24 hours of unloading, when no significant atrophy was detectable, there was no differential response to insulin for in vitro glucose metabolism. On day three, the soleus atrophied significantly and displayed a greater sensitivity to insulin for most of these parameters compared to the weight-bearing control muscle. However, insulin sensitivity for glycogen synthesis was unchanged. These results showed that the increased sensitivity to insulin of the unloaded soleus is associated with the degree of muscle atrophy, likely due to an increased insulin binding capacity relative to muscle mass. This study also showed that insulin regulation of glucose uptake and of glycogen synthesis is affected differentially in the unloaded soleus muscle. Author

A89-12754* Arizona Univ., Tucson.

ROLE OF GLUCOCORTICOIDS IN INCREASED MUSCLE GLUTAMINE PRODUCTION IN STARVATION

MARC E. TISCHLER, ERIK J. HENRIKSEN, and PAUL H. COOK

(Arizona, University, Tucson) Muscle and Nerve (ISSN 0148-639X), vol. 11, July 1988, p. 752-756. refs
(Contract NAGW-227; NAG2-384)

The role of glucocorticoids in the synthesis of muscle glutamine during starvation was investigated in adrenalectomized fasted rats injected with cortisol (1 mg/100 g body weight). It was found that administration of cortisol in vivo increased (compared to nontreated starved adrenalectomized controls) the glutamine/glutamate ratio and the activity of glutamine synthetase in the diaphragm and the extensor digitorum muscles, and that these effects were abolished by prior treatment with actinomycin D or proflavine. The results obtained in in vitro experiments, using fresh-frozen soleus, extensor digitorum longus, and diaphragm muscle preparations, supported the in vivo indications of the cortisol-enhanced glutamine synthesis and protein turnover in starved adrenalectomized animals. I.S.

A89-12755* Massachusetts Univ., Worcester.
EFFECTS OF IMMOBILIZATION ON RAT HIND LIMB MUSCLES UNDER NON-WEIGHT-BEARING CONDITIONS

STEPHEN R. JASPERS (Massachusetts, University, Worcester), JULIE M. FAGAN (Rutgers University, New Brunswick, NJ), SOISUNGWAN SATARUG, PAUL H. COOK, and MARC E. TISCHLER (Arizona, University, Tucson) Muscle and Nerve (ISSN 0148-639X), vol. 11, May 1988, p. 458-466. refs
(Contract NAGW-227; NAG2-384; NIH-AM-28647)

The effect of stretched and unstretched immobilization of a hind limb on the concentration and the metabolism of proteins in the hind-limb muscles of rats was investigated. The animals were divided into three groups: (1) weight-bearing controls, (2) tail-cast-suspended, and (3) suspended, with one hind limb immobilized with the ankle in dorsiflexion (30-40 deg angle) and the other freely moving. It was found that unloading the hind limbs for 6 days by tail cast suspension caused soleus to atrophy and reduced growth of the gastrocnemius and plantaris muscles; unloading resulted in a higher degradation rate and lower synthesis rate in both in vitro and in vivo. Chronic stretch of the unloaded soleus not only prevented its atrophy but led to significant hypertrophy, relative to weight-bearing controls, with increases in both the sarcoplasmic and myofibrillar protein fractions. Immobilizing one ankle in dorsiflexion prevented the inhibition of growth in the plantaris and gastrocnemius muscles due to unloading. I.S.

N89-10518*# State Univ. of New York, Stony Brook. Dept. of Biochemistry.

CHROMOSOMES AND PLANT CELL DIVISION IN SPACE Final Technical Report

A. D. KRIKORIAN 1988 70 p
(Contract NAG10-35)
(NASA-CR-183213; NAS 1.26:183213) Avail: NTIS HC A04/MF A01 CSCL 06C

The objectives were: examination of chromosomal aberrations; development of an experimental system; and engineering design units (EDUs) evaluation. Evaluation criteria are presented. Procedures were developed for shuttle-based investigations which result in the procurement of plant root tips for subsequent cytological examination. Author

N89-11383# Oak Ridge National Lab., Tenn. Chemical Technology Div.

A COMPOSITE PHOTOBIOELECTRONIC MATERIAL

E. GREENBAUM 1988 20 p Presented at the 10th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, Tenn., 16 May 1988
(Contract DE-AC05-84OR-21400)
(DE88-012490; CONF-880521-1) Avail: NTIS HC A03/MF A01

The research described presents a method for chemically modifying the surface of green plant photosynthetic membranes in such a way that electrical contact can be made. Colloidal platinum was prepared, precipitated directly onto photosynthetic thylakoid membranes from aqueous solution, and entrapped on fibreglass filter paper. This composition of matter was capable of sustained simultaneous photoevolution of hydrogen and oxygen when

irradiated at any wavelength in the chlorophyll absorption spectrum. Experimental data support the interpretation that part of the platinum metal catalyst is precipitated adjacent to the photosystem-I reduction site of photosynthesis and that electron transfer occurs across the interface between photosystem-I and the catalyst. When contacted with metal electrodes, the thylakoid-platinum combination is capable of generating a sustained flow of current through an external load resistor. Procedures for preparing this material and experimental data on its catalytic and electronic properties are presented. DOE

N89-11384*# Houston Univ., Tex. Dept. of Biology.
GROWTH OF PLANT TISSUE CULTURES IN SIMULATED LUNAR SOIL: IMPLICATIONS FOR A LUNAR BASE CELLS (CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM) Final Report, 1 Feb. 1987 - 31 Jul. 1988

S. VENKETESWARAN 1988 65 p
(Contract NAG9-214)
(NASA-CR-183233; NAS 1.26:183233) Avail: NTIS HC A04/MF A01 CSCL 06C

Experiments were carried out on plant tissue cultures, seed germination, seedling development and plants grown on Simulated Lunar Soil to evaluate the potential of future development of lunar based agriculture. The studies done to determine the effect of the placement of SLS on tissue cultures showed no adverse effect of SLS on tissue cultures. Although statistically insignificant, SLS in suspension showed a comparatively higher growth rate. Observations indicate the SLS, itself cannot support calli growth but was able to show a positive effect on growth rate of calli when supplemented with MS salts. This positive effect related to nutritive value of the SLS was found to have improved at high pH levels, than at the recommended low pH levels for standard media. Results from seed germination indicated that there is neither inhibitory, toxicity nor stimulatory effect of SLS, even though SLS contains high amounts of aluminum compounds compared to earth soil. Analysis of seedling development and growth data showed significant reduction in growth rate indicating that, SLS was a poor growth medium for plant life. This was confirmed by the studies done with embryos and direct plant growth on SLS. Further observations attributed this poor quality of SLS is due to it's lack of essential mineral elements needed for plant growth. By changing the pH of the soil, to more basic conditions, the quality of SLS for plant growth could be improved up to a significant level. Also it was found that the quality of SLS could be improved by almost twice, by external supply of major mineral elements, directly to SLS. Author

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AEROSPACE MEDICINE

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

A89-10456

AN ALTERED CONTROL POSITION FOR SIMULATING FLUID SHIFTS DURING SHUTTLE LAUNCH

JAMES T. WEBB (KRUG International Corp., Technology Services Div., San Antonio, TX), KENNETH W. SMEAD, and REBECCA INDERBITZEN (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 41-44. USAF-supported research. refs

Two control positions were studied relative to centrifuge simulations: (1) 6-deg head-down tilt, and (2) 6-deg head-down tilt with legs elevated further by bending at the knees and hip as if seated in the Shuttle launch position. The degree of fluid shifts under Shuttle launch G forces as compared to both head-down tilt controls suggests that 6-deg head-down tilt with legs elevated offers a closer fit with centrifuge data for this subject than the

traditional 6-deg head-down tilt in the prone position. Headward shift of fluids may be reduced by changing the launch position of the seat to 10 to 15 deg head up. K.K.

A89-10457

COGNITIVE WORKLOAD AND SYMPTOMS OF HYPOXIA

THOMAS E. NESTHUS (KRUG International Corp., Technology Services Div., San Antonio, TX), JOHN B. BOMAR, JR., RONALD D. HOLDEN, and ROBERT B. O'CONNOR (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 45-47. USAF-supported research.

The purpose of this study was to assess the potential impact high mental workload may have on a subject's ability to recognize and report symptoms of hypoxia. Subjective hypoxia questionnaire data from subjects exposed to comparable physiologic (objective) levels of hypoxia in a hypobaric chamber setting were compared, by subject, under two cognitive workload conditions. Nonparametric statistical analyses revealed, in all three subjective measures, a significant decrease in symptomatology reported under the high cognitive workload condition. These results suggest that an active high mental workload condition may have a negative effect on aircrew hypoxia symptom recognition. Research on hypoxia symptom recognition training procedures and state-dependent learning is therefore warranted to identify facilitatory effects on training transfer. A.

A89-10483

PHYSIOLOGIC BASES OF G-PROTECTION METHODS

RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 269-279. refs

It is shown that pilot group G-level tolerances can be calculated using a basic hydrostatic pressure equation with the incorporation of arterial blood pressure and intrathoracic pressure. The combination of these pressures in a single mathematical equation can be used to predict G-level tolerances resulting from the use of all known anti-G protective methods. It is noted that G-duration tolerances are linked to G-level tolerance so that improving G-level tolerances usually extends the duration of time that a pilot can tolerate an aerial combat maneuver. K.K.

A89-10587* RCA Government Services, Houston, Tex.

PHYSIOLOGICAL ADAPTATION - CREW HEALTH IN SPACE

SUSAN BRAND (RCA, Government Services Div., Houston, TX) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 93-96. refs (Contract NAS9-17133) (SAE PAPER 871872)

The experiments planned for the Spacelab Life Sciences-1 (SLS-1) Shuttle mission, which is dedicated to investigating biomedical issues pertinent to the man's presence in space, are discussed. The areas of research will include human and animal experiments concerned with the cardiovascular system, the vestibular apparatus, and metabolic experiments related to renal endocrine function, hematology, immune system, and muscle and bone/calcium metabolism, with particular attention given to the physiological complications resulting from short-duration space flight and subsequent return to the 1-G environment. The hardware systems to be used on the SLS-1 mission represent prototypes of systems to be developed for the medical and research facilities of the Space Station. The results of the experiments will be used to address issues related to long-duration space flight required for the Space Station and interplanetary travels. I.S.

A89-10747

DYNAMICS OF CYTOCHEMICAL INDEXES IN THE BLOOD OF FLIGHT PERSONNEL [DINAMIKA TSITOKHIMICHESKIKH POKAZATELEI KROVI U LETNOGO SOSTAVA]

P. S. PASHCHENKO Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), July 1988, p. 55-57. In Russian. refs

The effects of the pilot's age, total accumulated flight time, and the length of service on the contents of some of the white blood cell enzymes were investigated in a group of highly qualified pilots, using cytochemical techniques to quantify the cell constituents in the pilots and in a group of ground-based personnel. It was found that the age-induced changes in various cytochromic parameters, especially lipids and glycogen, were aggravated by the accumulation of flight time. In some pilots with more than 1500 hours of flight time, fat droplets were observed on the surface of red blood cells, together with abnormally large amounts of fat deposits inside leucocytes. The contents of two mitochondrial enzymes, succinate dehydrogenase and cytochrome oxidase, correlated negatively with flight time. I.S.

A89-10748

PHYSIOLOGICAL MECHANISMS OF AUTOGENIC TRAINING AND ITS APPLICATION TO SEAMEN DURING PROLONGED TRIPS [O FIZIOLOGICHESKIKH MEKHANIZMAKH AUTOGENNOI TRENIROVKI I EE PRIMENENII U MORIAKOV V DLITEL'NOM PLAVANII]

I. A. POGORELOV and E. G. SHIMANOVICH Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), July 1988, p. 57, 58. In Russian. refs

This paper describes the effects of autogenic training, using a procedure based on the psychological gymnastics developed by Repin (1979), on the occurrence of the symptoms of neurotic asthenia in fishing vessel personnel on a prolonged trip. The training, conducted between days 45 and 55 of the trip, was found to benefit 90 percent of the seamen, as compared to nontrained controls. The paper also discusses the processes taking place in various brain compartments in the course of an autogenic training procedure. I.S.

A89-11277

EFFECT OF DIFFERENT BODY POSTURES ON THE PRESSURES GENERATED DURING AN L-1 MANEUVER

CAROLE A. WILLIAMS, ALEXANDER R. LIND, RONALD L. WILEY, JOHN E. DOUGLAS, and GARY MILLER (East Tennessee State University, Johnson City, TN; Saint Louis University, MO; Miami University, Oxford, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 920-927. refs (Contract F33615-81-C-0500)

Changes in blood pressure, intrathoracic pressure, heart rate, and the electromyographic activity of various muscle groups were determined while nine male subjects performed 15-s L-1 straining maneuvers at four spine-to-thigh angles (70, 84, 94, and 105 deg) and two seatback angles (30 and 60 deg). There was no significant difference between the changes in these variables due to the different body positions. At the onset of the L-1, arterial pressure immediately increased to 195 + or - 5 mm Hg, but fell progressively during the next 5 s to 160 + or - 5 mm Hg. It remained constant during the next 5 s of the maneuver and then recovered to 180 + or - mm Hg during the last 5 s of the maneuver. Esophageal pressure followed essentially the same pattern of response, but heart rate progressively increased during the entire L-1. No one muscle group was utilized more than another. Inflation of an anti-G suit to 4 psi had no effect on the variables measured. Generation of high arterial pressures during L-1 maneuvers is transitory and not affected either positively or negatively by altering subject body position. Author

A89-11278* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

BINAURAL SPEECH DISCRIMINATION UNDER NOISE IN HEARING-IMPAIRED LISTENERS

K. V. KUMAR (NASA, Johnson Space Center, Houston, TX; Institute of Aviation Medicine, Bangalore, India) and A. B. RAO (Institute of Aviation Medicine, Bangalore, India) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 932-936. refs

This paper presents the results of an assessment of speech discrimination by hearing-impaired listeners (sensori-neural,

conductive, and mixed groups) under binaural free-field listening in the presence of background noise. Subjects with pure-tone thresholds greater than 20 dB in 0.5, 1.0 and 2.0 kHz were presented with a version of the W-22 list of phonetically balanced words under three conditions: (1) 'quiet', with the chamber noise below 28 dB and speech at 60 dB; (2) at a constant S/N ratio of +10 dB, and with a background white noise at 70 dB; and (3) same as condition (2), but with the background noise at 80 dB. The mean speech discrimination scores decreased significantly with noise in all groups. However, the decrease in binaural speech discrimination scores with an increase in hearing impairment was less for material presented under the noise conditions than for the material presented in quiet. I.S.

A89-11279**AN ANALYSIS OF NOISE-INDUCED HEARING LOSS IN ARMY HELICOPTER PILOTS**

DANIEL T. FITZPATRICK (Hawaii, University, Manoa; U.S. Army, Flight Surgeons Office, Schofield Barracks, HI) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 937-941. refs

This study was conducted to determine the relative contribution of age, total flight hours, type of aircraft, and the use of hearing protection to hearing loss in U.S. Army aviators. Information from a survey of the aviators in an aviation brigade was combined with audiometric records to create the data file. The final study group, 83 percent of the unit aviators, was evaluated for hearing loss using two criteria: (1) existing U.S. army standards, and (2) four empirical categories of significant threshold shift. Data analysis suggests that hearing loss is primarily a function of noise exposure as measured by total flight hours. Age was found to be a less significant factor; aircraft type had no significant effect. The results indicate that combination hearing protection appears to significantly lower the risk of hearing loss. Author

A89-11280**ACUTE MOUNTAIN SICKNESS AT 4500 M IS NOT ALTERED BY REPEATED EIGHT-HOUR EXPOSURES TO 3200-3550 M NORMOBARIC HYPOXIC EQUIVALENT**

RICHARD L. BURSE and VINCENT A. FORTE, JR. (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 942-949. refs

A89-11282**INTRAVENTRICULAR CONDUCTION DISTURBANCES IN FLYING PERSONNEL - INCOMPLETE RIGHT BUNDLE BRANCH BLOCK**

GERARDO CANAVERIS (Instituto Nacional de Medicina Aeronautica y Espacial, Buenos Aires, Argentina) and M. SUSANA HALPERN (Ramos Mejia Hospital, Buenos Aires, Argentina) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 960-964. refs

This paper studies the evolving characteristics, as well as the qualification criteria, applied to 261 filters with incomplete right bundle branch block (IRBBB), detected in a presumable healthy population of 7685 males engaged in civilian flying activities. In 136 cases, the IRBBB was detected in the first electrocardiogram. The highest prevalence was observed between 20 and 29 years of age. The IRBBB was permanent in 77 cases and transitory in the remaining 195. The electrical axis shifted to the left in 94 cases. Twelve cases (4.6 percent) evolved to complete RBBB. The IRBBB pattern implies many different clinical conditions. Flying fitness certification depends upon the cause of the IRBBB. Those due to conduction disturbance with no underlying pathology may be qualified. IRBBB associated with other conduction disturbance deserves further study for possible restricted qualification. Author

A89-11283**BIOCHEMICAL SCREENING OF AIRMEN**

T. HARDARSON, U. THORDARSON, E. O. ARNARSON, and L.

FRANZSON (Civil Aviation Administration, Reykjavik, Iceland) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 965-967. refs

This paper presents the results of biochemical and hematological screening, since 1983, of all Icelandic captains (114 subjects), copilots (113), flight engineers (61), and air traffic controllers (64), all of them male. No hematological abnormalities were observed in these subjects. Forty eight airmen had serum cholesterol above 8.9 mmol/l, and 15 airmen had glucose above 7.9 mmol/l. Pilots had significantly lower serum triglycerides, alanine aminotransferase (AT), and aspartate AT than the captains. Fifty airmen had gamma glutamyltransferase (G-GT) values above 50 IU/l. This group was given medical and psychological advice (concerning, in particular, their alcohol habits); during following two years, the mean G-GT in this group fell from 89 to 37 IU/l. I.S.

A89-11284**A PRELIMINARY REPORT ON A NEW ANTI-G MANEUVER**

HONG-ZHANG GUO, SHU-XIA ZHANG, BAI-SHENG JING, and LI-MIN ZHANG (Air Force, Institute of Aviation Medicine, Beijing, People's Republic of China) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 968-972. refs

This paper describes a new anti-G maneuver, termed the Q-G maneuver, which is based on the traditional Chinese medicine and Qigong. The Q-G maneuver involves the volition mobilization, tensing of leg and abdominal muscles during the onset of G-load, and the maintenance of a shallow thoracic respiration throughout the maneuver. The subjects performing the maneuver (24 pilots on ground and three in a G-centrifuge) were monitored for cardiovascular parameters and peripheral vision. The pilots subjected to G acceleration, were found to tolerate G loads that were 2.25-3.0 G higher than without the maneuver without displaying peripheral vision disturbance. Oximetry readings were 96-97 percent, and there was no evidence of hyperventilation. I.S.

A89-12447**PUTATIVE MELATONIN RECEPTORS IN A HUMAN BIOLOGICAL CLOCK**

STEVEN M. REPERT, DAVID R. WEAVER, SCOTT A. RIVKEES (Massachusetts General Hospital; Harvard University, Boston), and EDWARD G. STOPA (Tufts University, Boston; McLean Hospital, Belmont, MA) Science (ISSN 0036-8075), vol. 242, Oct. 7, 1988, p. 78-81. refs

(Contract PHS-HD-14427; PHS-NS-31862)
Melatonin binding sites in the human hypothalamus were studied using in vitro autoradiography with I-125 labeled melatonin. It was found that the labeled melatonin binding was localized to the suprachiasmatic nuclei, the site of a putative biological clock. Densitometric analysis of competition experiments with varying concentrations of melatonin showed monophasic competition curves with comparable half-maximal values for the suprachiasmatic nuclei of adults (150 picomolar) and fetuses (110 picomolar). I-125 labeled melatonin binding was completely inhibited by micromolar concentrations of chloromelatonin, but was only partially inhibited by the same concentrations of serotonin and norepinephrine. It is concluded that putative melatonin receptors are located in a human biological clock. R.B.

N89-10463# Queensland Univ., St. Lucia (Australia). Dept. of Electrical Engineering.

A REVIEW OF MEDICAL ASPECTS OF LIGHTNING INJURY

C. J. ANDREWS, M. DARVENIZA, and D. MACKERRAS In NOAA, International Aerospace and Ground Conference on Lightning and Static Electricity p 231-250 Apr. 1988
Avail: NTIS HC A23/MF A01 CSCL 06P

Many disparate reports of the pathological and pathophysiological effects of lightning on an injured person are drawn together into a coherent review representing the current state of knowledge of the physico-medical effects of lightning. Special attention is paid to those effects of lightning which distinguish it from other electrical injuries. These include

neurological and psychiatric syndromes, burns of specific types, cardio-respiratory signs of a particular nature and other, more general, effects. The nature of all of these injuries is given, with current theories of their genesis. The importance of the recognition of lightning injuries from the forensic viewpoint is presented, and a review of current treatment regimens is given with an emphasis on first aid. Finally, a formal review of 221 literature cases is given, placing in perspective the incidence of the varied injuries presented in the foregoing discussion. Author

N89-10464# Queensland Univ., St. Lucia (Australia). Dept. of Electrical Engineering.

A RETROSPECTIVE STUDY OF THE INJURIES SUSTAINED IN TELEPHONE-MEDIATED LIGHTNING STRIKE

C. J. ANDREWS, M. DARVENIZA, and D. MACKERRAS. In NOAA, International Aerospace and Ground Conference on Lightning and Static Electricity p 251-271 Apr. 1988

Avail: NTIS HC A23/MF A01 CSCL 06P

Injuries due to lightning impulses mediated by the public telephone system are discussed. The reported frequency of symptoms are compared with those previously presented for in-the-field strikes, as is the spectrum of injury sustained. The main thrust here is a retrospective study of 328 persons in Australia claiming telephone related injury in the period 1980 to 1985. The study aimed to obtain a complete medical history taken from these individuals with regard to their injury. The histories were analyzed and three distinct lightning strike syndromes were identified with their own clinical pictures and relative frequencies of occurrence. The histories of injury obtained in the survey were further compared with those obtained by the medical practitioners they consulted. A brief discussion is given of the physical mechanisms by which these injuries are thought to occur, together with hypotheses regarding those factors which are thought to have contributed to the recent upsurge in reports. Author

N89-10519# Army Research Inst. of Environmental Medicine, Natick, Mass.

MODULATION OF HUMAN PLASMA FIBRONECTIN LEVELS FOLLOWING EXERCISE

DAVID A. DUBOSE, L. E. ARMSTRONG, W. J. KRAEMER, and M. LUKASON Jan. 1988 23 p
(AD-A192674; USARIEM-M-18/88) Avail: NTIS HC A03/MF A01 CSCL 06J

Tissue and Plasma Fibronectin (PF) represent two forms of this large molecular weight (440 kilodaltons) glycoprotein. While the tissue type is cell-associated and important to cell adhesion and shape, PF circulates in the blood and serves as a nonspecific opsonin for the reticuloendothelial system (RES). Although it may not participate in all forms of RES clearance, PF is an important contributor to this RES function. It supports particulate clearance by binding to material released to the vascular space as the result of tissue injury and thereby enhances the engulfment of this debris by the phagocytic cells of the RES. In this way, PF influences blood vessel patency and continued blood flow. Augmentation of particulate clearance by PF is perhaps one explanation for the correlation between elevated RES function and increased survival after shock. RES function and PF are suppressed after shock and trauma. Trauma-induced organ failure correlates with reduced PF level. While PF concentration rapidly recovers in survivors that have experienced traumatic episodes, it remains suppressed in nonsurvivors. Immunoglobulin reduction of PF results in decreased phagocytosis and decreased resistance to shock. Moreover, experimental rat heat stress mortality rate is significantly lessened by increased RES clearance capacity and naturally occurring elevations in PF level. Hence, elevation of PF may influence the outcome of trauma and correlate with the degree of tolerance to environmental stress. GRA

N89-11385 Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
12 Aug. 1987 100 p Transl. into ENGLISH from various Russian

articles

(JPRS-ULS-87-010) Avail: Issuing Activity

Topics addressed include: agricultural science biochemistry; epidemiology; medicine; biophysics; environment; laser bioeffects; marine mammals; toxicology; microbiology; pharmacology; virology; physiology; radiation biology; and public health.

N89-11386 Joint Publications Research Service, Arlington, Va.

INDIVIDUAL DIFFERENCES IN ADAPTATION TO HYPOXIA AND COLD BASED ON EMOTIONAL-BEHAVIORAL CRITERION OF BODILY REACTIVITY Abstract Only

V. B. ZAGUSTINA, Z. A. ALEKSANYAN, and N. N. VASILEVSKIY
In its JPRS Report: Science and Technology. USSR: Life Sciences p 58 12 Aug. 1987 Transl. into ENGLISH from Uspekhi Fiziologicheskikh Nauk (Moscow, USSR), v. 17, no. 4, Oct. - Dec. 1986 p 68-84 Original language document was announced in IAA as A87-24261

Avail: Issuing Activity

Hypoxia is one of the more critical problems in modern medicine. Resistance to hypoxia depends on the level of the development of the nervous system. The most sensitive to oxygen insufficiency are animals with poor higher nerve activity. Those without fear, insensitive to provocation factors and those showing tendency to social domineering are more resistant to acute hypoxia. Data on individual differences to the adaptation to hypoxia are reviewed here. The role of emotional-behavioral reaction is pointed out. Adaptation to cold and hypoxia appears to be based on complex system interaction. This is especially crucial in rapid adaptations and should be considered carefully in optimizing training of alpinists. IAA

N89-11387# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

EFFECT OF PHYSICAL FITNESS ON RESPONSE TO ORTHOSTASIS IN HEALTHY YOUNG WOMEN M.S. Thesis

CAROLYN K. GOOCH 1988 78 p
(AD-A196377; AFIT/CI/NR-88-3) Avail: NTIS HC A05/MF A01 CSCL 06D

The purpose of this study was to examine the relationship between fitness level and cardiovascular response to orthostatic stress in healthy women between the ages of 20 and 35. Subjects were divided into three groups on the basis of VO2max: High-Fit (n = 4; mean VO2max = 57.8 ml/kg/min); Med-Fit (n = 8; mean VO2max = 46.4 ml/kg/min); and Low-Fit (n = 4; mean VO2max = 34.7 ml/kg/min). Subjects were exposed to three trials of 70 deg head up tilt each followed by a ten minute supine rest period. Heart rate and blood pressure were recorded at 1, 3 and 5 minute intervals during head up tilt and at 5 and 10 minute intervals during the supine rest period. The mean heart rate and blood pressure changes from supine to one minute upright were calculated for each group. The change in heart rate per change in systolic blood pressure from supine to 70 deg upright was used as an index of baroreflex responsiveness. There was a strong inverse correlation between fitness level and heart rate both resting and at 1 minute upright ($r = .83$; $r = .84$ p less than .001). An analysis of baroreflex indices between groups showed no fitness related differences in heart rate and blood pressure response to orthostasis. GRA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A89-10110#

RESPONSE OF AIRLINE PILOTS TO VARIATIONS IN FLIGHT SIMULATOR MOTION ALGORITHMS

LLOYD D. REID and MEYER A. NAHON (Toronto, University,

Canada) Journal of Aircraft (ISSN 0021-8669), vol. 25, July 1988, p. 639-646. NSERC-supported research. Previously cited in issue 21, p. 3464, Accession no. A87-49167. refs

A89-10577

TRANSPORT AIRCRAFT CREW WORKLOAD ASSESSMENT - WHERE HAVE WE BEEN AND WHERE ARE WE GOING?

DIANE L. SANDRY-GARZA, GEORGE P. BOUCEK, JR., AILEEN L. LOGAN (Boeing Commercial Airplane Co., Seattle, WA), MICHAEL A. BIFERNO, and WILLIAM H. CORWIN (Douglas Aircraft Co., Long Beach, CA) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 5-14. refs (SAE PAPER 871769)

Methods for the assessment of the transport aircraft crew workload are discussed. Consideration is given to the application of existing analytic techniques of work-load assessment to the aircraft design and certification and to the application of structured subjective measurement techniques. New work-load assessment techniques with potential application to design and certification are examined, and the validity and reliability considerations for work-load measurement are discussed. Special attention is given to the practicality and applicability considerations in the flight deck environment. I.S.

A89-10578* San Jose State Univ., Calif.

PILOT WORKLOAD PREDICTION

DAVID D. PEPITONE (San Jose State University, CA), ROBERT J. SHIVELY (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA), and MICHAEL R. BORTOLUSSI (NASA, Ames Research Center; Western Aerospace Laboratories, Inc., Moffett Field, CA) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 15-21. refs (SAE PAPER 871771)

A predicting model of pilot workload is developed using a time-based algorithm, work-load values from previous research, and experimental data obtained by a group of experienced pilots on a Singer-Link Gat-1 instrument trainer with three degrees of motion (roll, pitch, and yaw). Each pilot performed three experimental flights presented in a counterbalanced order; each flight consisted of short, medium, or long cruise and initial approach segments. Results strongly suggest that pilots were more sensitive to the rate at which work was done than to the total amount of work accomplished. The result of predictions obtained with the model showed that the time-weighted average of the component work-load ratings were able to predict the obtained work-load ratings accurately. I.S.

A89-10579

FITNESS FOR DUTY - A TEAM APPROACH

PHYLLIS J. KAYTEN and JOHN K. LAUBER (National Transportation Safety Board, Washington, DC) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 25-29. refs (SAE PAPER 871713)

Measures that can be taken by management to predict and prevent factors which negatively affect crew fitness are discussed, with special attention given to the environment and policies conducive to fitness for duty. The paper discusses the aspects of a training program which would provide guidelines for crew members in determining how to recognize the symptoms of stress and subtle incapacitation in others, how and when to compensate for incapacitation, and when not to attempt to compensate (i.e., call off the flight or trip). An example is presented illustrating the role of management in creating and perpetuating a system which provided opportunity for deterioration of fitness for duty in crew members, resulting in a fatal accident. I.S.

A89-10693

HUMAN ERROR AVOIDANCE TECHNIQUES CONFERENCE, WASHINGTON, DC, DEC. 1-3, 1987, PROCEEDINGS

Conference sponsored by SAE. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE Proceedings P-204), 1988, 96 p. For individual items see A89-10694 to A89-10707. (SAE P-204)

The papers presented in this volume deal with the problem of the avoidance of human error in the aerospace industry. The topics covered include problem definition and system application, human error data and information sources, analysis techniques, and current problem approaches. Papers are included on the management of human error by design; human factors and the U.S. Air Force Aircraft Mishap Prevention program; data bases in aviation incidents resulting from human error; software systems safety and human error avoidance; and advanced technology cockpit design and the management of human error. V.L.

A89-10694

THE NECESSARY SYSTEMS APPROACH

VERNON L. GROSE (Omega Systems Group, Arlington, VA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 1-6. (SAE PAPER 872504)

Current trends and characteristics of the aerospace industry relevant to the problem of human error avoidance (e.g., increasing complexity, mechanization, and specialization) are briefly reviewed. It is emphasized that human error can be avoided, or at least controlled, best by viewing the setting within which it occurs as a bounded defined system. The failure to recognize the importance of this approach greatly reduces the effectiveness of human error avoidance. V.L.

A89-10695* Miami Univ., Coral Gables, Fla.

MANAGEMENT OF HUMAN ERROR BY DESIGN

EARL WIENER (Miami University, Coral Gables, FL) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 7-11. refs (Contract NCC2-377) (SAE PAPER 872505)

Design-induced errors and error prevention as well as the concept of lines of defense against human error are discussed. The concept of human error prevention, whose main focus has been on hardware, is extended to other features of the human-machine interface vulnerable to design-induced errors. In particular, it is pointed out that human factors and human error prevention should be part of the process of transport certification. Also, the concept of error tolerant systems is considered as a last line of defense against error. V.L.

A89-10696

HUMAN FACTORS AND THE U.S. AIR FORCE AIRCRAFT MISHAP PREVENTION PROGRAM

DAVID PORTERFIELD and ALAN DIEHL (USAF, Inspection and Safety Center, Norton AFB, CA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 13-16. (SAE PAPER 872506)

The Aircraft Mishap Prevention program, which is currently being developed to provide the USAF with a more timely and scientifically valid understanding of human factors issues, is briefly reviewed. The program will involve the application of epidemiologic and computer assisted information management concepts to three types of activities: surveillance, assessment, and countermeasures development. The discussion covers the history of USAF mishap data bases, limitations of traditional methods, current human factors emphasis, judgement dimensions, two-level coding, and analysis strategies. V.L.

A89-10697**U.S. ARMY HUMAN-ERROR-RELATED DATA BASES**

M. BRUCE MCGEHEE, JAMES E. HICKS (U.S. Army, Safety Center, Fort Rucker, AL), and RICHARD N. ARMSTRONG (U.S. Army, Human Engineering Laboratory, Fort Rucker, AL) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 17-22. refs (SAE PAPER 872507)

Human error has been shown to be a major factor influencing U.S. Army aviation and ground safety. This paper reviews human-error-related Army aviation mishap data and trends. It also describes the Army data bases related to safety issues, providing information on the data contents, access, capabilities and applications. Additionally, the paper discusses current Army initiatives toward resolution of human error safety problems.

Author

A89-10698**HUMAN ERROR MISHAP CAUSATION IN NAVAL AVIATION**

ROBERT A. ALKOV (U.S. Naval Safety Center, Norfolk, VA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 23-26. refs (SAE PAPER 872508)

The naval aviation mishap rate has declined from almost eighteen aircraft destroyed per 100,000 flight hours thirty three years ago to today's rate of three and a half, as the result of better aircraft design, maintenance, and training. However, pilot error, usually accounting for slightly less than half of the aircraft mishap causation, has shown a recent increase. The reasons most often cited for these pilot errors are violations of air discipline, poor crew coordination, lack of judgment, and a loss of situational awareness. The Navy has recently initiated a trial program to teach skills in these areas to pilots.

Author

A89-10699**DATA BASES OF AVIATION INCIDENTS RESULTING FROM HUMAN ERROR**

WILLIAM R. HENDRICKS (FAA, Washington, DC) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 27-36. (SAE PAPER 872511)

This paper presents a description of several Federal Aviation Administration (FAA) incident data systems that contain information on events which result primarily from human error. These data systems include reports of near midair collisions, operational errors, pilot deviations, and events reported through the Aviation Safety Reporting System (ASRS). Over 17,000 incident reports are received and stored in these data bases annually. This paper discusses the information content of the data bases, reporting procedures, system limitations, proposed improvements, and uses of the data.

Author

A89-10706**MANAGING HUMAN PERFORMANCE - INPO'S HUMAN PERFORMANCE EVALUATION SYSTEM**

JOE BISHOP and RICHARD LARHETTE (Institute of Nuclear Power Operations, Atlanta, GA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 79-85. (SAE PAPER 872526)

The current status of the Human Performance Evaluation System, a program designed by the Institute of Nuclear Power Operations (INPO) with the objective of improving human reliability in overall nuclear plant operations by reducing human error through correction of the underlying causes, is reviewed. The following five main categories of root causes are identified: plant human performance problems, design related human performance problems, manufacturing related human performance problems, external problems, and other/unknown problems. Preempting errors

and correcting the root causes make up the key elements of the human performance management system applied at nuclear facilities.

V.L.

A89-10707**HUMAN PERFORMANCE IN A TECHNICAL SOCIETY - THE ARMY APPROACH**

HAROLD R. BOOHER (U.S. Army, Washington, DC) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 87-91. (SAE PAPER 872524)

The Manpower and Personnel Integration (MANPRINT) program which has been developed by the Army with the aim of enhancing total system performance and reliability through human factors policy improvements regarding Army materiel acquisitions, is reviewed, and its potential ramifications for human error avoidance are discussed. To be effective, MANPRINT has become fully integrated in the documentation process which controls each step of Army materiel acquisition. Some of the Army's recent efforts in operator workload and safety research are also discussed.

V.L.

A89-11276**PILOTS' ATTITUDES TOWARD ALCOHOL USE AND FLYING**

LEONARD E. ROSS and SUSAN M. ROSS (Wisconsin, University, Madison) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 913-919. (Contract PHS-AA-6093)

Questionnaires were sent to a national sample of licensed pilots. Respondents reported their flying experience and their drinking behavior. They also indicated the number of drinks that they believed could be safely consumed 3 hours (h) before flying or driving, and estimated the number of hours a person should wait, after drinking, before attempting to fly or drive. Similar questions were included regarding marijuana use. Respondents were much more conservative in their attitudes toward the use of alcohol prior to flying than prior to driving. This relationship held both for the number of drinks judged safe 3 h prior to flying or driving and for estimates of the waiting interval that would be appropriate following alcohol consumption. In addition, attitudes toward alcohol use were related to respondents' own drinking behavior, with moderate and heavy drinkers more tolerant of alcohol use in flying and driving situations than abstainers.

Author

A89-11281**THE RIGHT AND WRONG STUFF IN CIVIL AVIATION**

PATT HUGO O. LEIMANN (Instituto Nacional de Medicina Aeronautica y Espacial, Buenos Aires, Argentina) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 955-959. refs

Aircrewmembers (ACMs) enter a mortally hostile environment when they take off from earth in their flying machines. Their physiological adaptation has been augmented and supported through ergonomics, avionics, and engineering, but no such technological aid helps them adapt their minds to that atypical condition. They must rely upon their own psychic resources, i.e. 'aeronautical motivation' in the three levels of consciousness, and defense mechanisms to counteract their 'aeronautical anxiety'. Various relationships of motivation and defense give rise either to the flying adaptation syndrome or the various forms of the secondary flying disadaptation syndrome when ACMs must face the dangers of flight. These alterations of the ACM's psychic balance may cause temporary or permanent medical disqualification due to the impairment of safety which they provoke. This paper proposes an analysis of the interplay between motivation, psychic defenses, and aviation stress to explain the manifestations of flight adaptation and disadaptation seen in some aircrewmembers.

Author

A89-11285**THE AVIATION PSYCHOLOGY PROGRAM AT RAF UPPER HEYFORD**

PETER K. SENECHAL and ANTHONY C. TRAWEEK (USAF,

53 BEHAVIORAL SCIENCES

Hospital, RAF Upper Heyford, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 973-975.

The goals of an aviation psychology program at RAF Upper Heyford, England, which was started in September, 1985, for flight commanders and their wives, are discussed together with the results achieved. The aviation psychologist involved in the program devoted approximately 20 percent of his time to the flying community and was also involved in flying activities. Case reports are presented which demonstrate the value of the program for reducing stress in aircrew members and their family members, and for improving the performance of fighter pilots. I.S.

A89-11286* Maryland Univ., Baltimore.

PROGRAMMED ENVIRONMENT MANAGEMENT OF CONFINED MICROsociETIES

HENRY H. EMURIAN (Maryland, University, Baltimore) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1988, p. 976-980. refs

(Contract NGR-21-001-111; N00014-80-C-0467)

A programmed environment is described that assists the implementation and management of schedules governing access to all resources and information potentially available to members of a confined microsociety. Living and work schedules are presented that were designed to build individual and group performance repertoires in support of study objectives and sustained adaptation by participants. A variety of measurement requirements can be programmed and standardized to assure continuous assessment of the status and health of a confined microsociety. Author

A89-11659#

LINEAR SYSTEM IDENTIFICATION USING MATRIX EXPONENTIAL SENSITIVITIES

F. M. TSEN and D. J. MOOK (New York, State University, Buffalo) IN: Dynamics and control of large structures; Proceedings of the Sixth VPI&SU/AIAA Symposium, Blacksburg, VA, June 29-July 1, 1987. Blacksburg, VA, Virginia Polytechnic Institute and State University, 1988, p. 119-126.

A novel technique for estimation of the unknown parameters in a linear time-invariant dynamic system model is derived and demonstrated on some example problems. The method uses matrix exponentials to calculate the state vector and state vector sensitivities to the unknown parameters. Experimental data consist of discrete, state-observable, free or forced time-domain measurements. Corrections to the unknown parameters are calculated using the matrix exponential sensitivities along with residuals between the integrated solution and the measurements. The results demonstrate that the method is very accurate, not sensitive to initial guessed values of the unknown parameters, and only slightly sensitive to significant measurement noise. Author

A89-12054* Washington Univ., St. Louis, Mo.

ROBOT ARM FORCE CONTROL THROUGH SYSTEM LINEARIZATION BY NONLINEAR FEEDBACK

T. J. TARN (Washington University, Saint Louis, MO), A. K. BEJCYZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena), and XIAOPING YUN (Pennsylvania, University, Philadelphia) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 3. Washington, DC, Computer Society Press, 1988, p. 1618-1625. refs

(Contract NSF DMC-83-09527; NSF DMC-85-05843; NSF ECS-85-15899; NSF INT-85-19654)

Based on a differential geometric feedback linearization technique for nonlinear time-varying systems, a dynamic force control method for robot arms is developed. It uses active force-moment measurements at the robot wrist. The controller design fully incorporate the robot-arm dynamics and is so general that it can be reduced to pure position control, hybrid position/force control, pure force control. The controller design is independent of the tasks to be performed. Computer simulations show that the

controller improves the position error by a factor of ten in cases in which position errors generate force measurements. A theorem on linearization of time-varying system is also presented. I.E.

N89-10520# Katholieke Universiteit, Nijmegen (Netherlands). Mathematical Psychology Group.

ORDMET3: AN IMPROVED ALGORITHM TO FIND THE MAXIMUM SOLUTION TO A SYSTEM OF LINEAR (IN)EQUALITIES

E. E. ROSKAM 1987 35 p

(PB88-208970; REPT-87-MA-06) Avail: NTIS HC A03/MF A01 CSCL 051

An improved algorithm, called ORDMET3, for psychological measurement and scaling data, is used to find both a set of solutions to a system of linear (in)equalities and the maximum r solution. As such, it improves on the algorithms of others. The present algorithm is faster and requires less storage capacity, is more robust in finding the maximum r solution, and can process linear equality constraints. GRA

N89-10521# Pacific Northwest Labs., Richland, Wash.

EFFECT OF A 12-HOUR/DAY SHIFT ON PERFORMANCE

PAUL M. LEWIS and DAN J. SWAIM (Westinghouse Hanford Co., Richland, Wash.) Jun. 1988 11 p Presented at the 4th International Conference on Human Factors and Power Plants, Monterey, Calif., 5 Jun. 1988

(Contract DE-AC06-76RL-01830)

(DE88-013184; PNL-SA-15620; CONF-880633-7) Avail: NTIS HC A03/MF A01

The operating crews at the Fast Flux Facility near Richland, Washington, changed their rotating shift schedule from an 8- to 12-hour per day work schedule. The primary reason for the change was to reduce the attrition of operators by increasing their job satisfaction. Eighty-four percent of the operators favored the change. Plant performance and safety were not adversely affected. A statistical analysis of 53 operator-related, off-normal events in 28 months concluded that there was no significant difference in either the number or the severity of off-normal events on the 12-hour shift. A statistical analysis of 200,000 log entries concluded that the error rate in completing logs actually declined by 25 percent on the 12-hour shift. Alertness, which was measured using computerized tests of mathematics and logical reasoning, reach a nadir on the first night shift for the 8- and 12-hour schedules alike, which indicates that the primary cause of fatigue was sleep disruption, not cumulative hours of work. All supervisors and 52 percent of the operators believe their crews work more effectively on the 12-hour shift; only 12 percent of the operators believe that their crews work less effectively. The evaluation indicated that the 12-hour shift scheduled is a reasonable alternative to an 8-hour schedule at this facility. DOE

N89-11388# Haifa Univ. (Israel). Centre for Study of Psychological Stress.

ENHANCING PERFORMANCE UNDER STRESS BY INFORMATION ABOUT ITS EXPECTED DURATION Interim Report, May - Dec. 1987

SHLOMO BREZNITZ Jun. 1988 33 p

(Contract DAJA45-86-C-0048; DA PROJ. 2Q1-61102-B-74-F) (AD-A196836; ARI-RN-88-53) Avail: NTIS HC A03/MF A01 CSCL 06J

This research note discusses experiments in which four groups of subjects were given two stressful tasks; the Dynamometer test, and the Cold Pressor test. At the same time, the test subjects were given different information about the tests' duration. The information conditions were: no information, exact information, false long (with subsequent encouraging correction), and false short (with subsequent discouraging correction). Endurance was highest with the exact information condition, lowest in the no information condition, and the other two groups produced intermediate results. Timing of the maximal heart rate during the task was systematically related to information, and its role as a potential indicator of psychological breakdown was analyzed. GRA

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A89-10153

MAGNETOENCEPHALOGRAPHY - THE USE OF MULTI-SQUID SYSTEMS FOR NONINVASIVE BRAIN RESEARCH

JUKKA KNUUTILA (Helsinki University of Technology, Espoo, Finland) (European Physical Society, Trends in Physics EPS-7, General Conference, 7th, Espoo, Finland, Aug. 10-14, 1987) *Physica Scripta* (ISSN 0281-1847), vol. T23, 1988, p. 306-311. refs

Some of the basic concepts of magnetoencephalography (MEG) and neuromagnetic instrumentation are reviewed. Examples of multichannel SQUID magnetometers and results of measurements with them are presented. Current trends in MEG instrument development are discussed. Author

A89-10452

SAFE ASSOCIATION, ANNUAL SYMPOSIUM, 25TH, LAS VEGAS, NV, NOV. 16-19, 1987, PROCEEDINGS

Symposium sponsored by the SAFE Association. Newhall, CA, SAFE Association, 1987, 289 p. For individual items see A89-10453 to A89-10483.

The conference presents papers on the attrition of a molecular sieve in on-board oxygen generating systems, Space Station emergency egress and EVA lighting considerations and candidate Koch hardware, performance criteria for the MSOGS, and an altered control position for simulating fluid shifts during Shuttle launch. Other topics include cognitive workload and symptoms of hypoxia, development of an oxygen mask integrated arterial oxygen saturation (SaO₂) monitoring system for pilot protection in advanced fighter aircraft, and eyeblink monitoring as a means of measuring pilot psychological state. Consideration is also given to a new approach to head and neck support, the prediction of Hybrid II manikin head-neck kinematics and dynamics, pyrolaser and optical initiator development, safety in man-machine interfaces, and a passive thermal protection system. K.K.

A89-10453

ATTRITION OF MOLECULAR SIEVE IN ON BOARD OXYGEN GENERATING SYSTEMS

CHERIE J. NOLES (KRUG International Corp., Technology Services Div., San Antonio, TX) and KENNETH G. IKELS (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 12-15.

In an attempt to study attrition in molecular sieve beds, a gas switching unit was developed that subjected a single bed from different molecular sieve oxygen generating systems to simulated aircraft conditions. During the test period, product and exhaust gas samples were examined for the presence of dust. It is shown that the molecular sieve attrition may be caused by a combination of factors including the molecular sieve's exposure to liquid water, vibrations, and bed loading. When operating under no load with exposure of the molecular sieve to liquid water, there was evidence of dusting. K.K.

A89-10455

PERFORMANCE CRITERIA FOR THE MSOGS

KENNETH G. IKELS, JOHN B. BOMAR, JR., and RICHARD L. MILLER (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 29-34. refs

The physiological requirements for aircrew breathing oxygen are reviewed. Recommendations are provided on both the scope

and content of procurement and use specifications for breathing gas produced and delivered by aircraft onboard molecular sieve oxygen generating systems (MSOGS). It is noted that contaminant testing (carbon monoxide and hydrocarbon analyses) should be carried out on the aircraft-installed MSOC system only when there has been a physiological incident in which the oxygen system is implicated or contamination is suspected. K.K.

A89-10458

DEVELOPMENT OF AN OXYGEN MASK INTEGRATED ARTERIAL OXYGEN SATURATION (SAO₂) MONITORING SYSTEM FOR PILOT PROTECTION IN ADVANCED FIGHTER AIRCRAFT

LLOYD D. TRIPP and WILLIAM B. ALBERY (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 84-88. refs

An integrated arterial-oxygen-saturation-monitor oxygen mask system that monitors a pilot's SaO₂ level, pulse rate, and pulse waveform, even under 9 Gz, is described. Since the sensors are integrated in the nose bridge of the standard 12-P oxygen mask and the sensor leads can be incorporated into the microphone leads and jack coming from the mask, the system is completely blind to the pilot. It is noted that the pulsatile flow creates a transient change in the light path, modifying the amount of light received by the photocell. The device compares well with blood cuvette and other methods of measuring SaO₂. K.K.

A89-10459

EYEBLINK MONITORING AS A MEANS OF MEASURING PILOT PHYSIOLOGICAL STATE

PATRICK M. O'BRIEN (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 89-91.

An attempt was made to determine whether the pilot loss of consciousness (PLOC) monitor is an effective means of detecting g-induced loss of consciousness through the monitoring of a pilot's eyeblink. The PLOC employs an oxygen-mask-mounted IR emitter/reciever and a microprocessor to collect and process the light reflected from the eyelid and sclera to determine when a blink occurs. The PLOC monitor detected more than 90 percent of the subject's blinks during the test. K.K.

A89-10460

OBOGS - A TECHNICAL UPDATE OF SYSTEM FEATURES AND OPTIONS

ROBERT L. CRAMER (Litton Systems, Inc., Clifton Precision Instruments and Life Support Div., Davenport, IA) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 92-94.

Molecular sieve oxygen systems are divided into major components and each is discussed from the point of view of interface with aircraft. The general effects of a molecular sieve filled plenum are analyzed. It is noted that the choice of breathing regulator for use with any specific MSOGS application is influenced essentially by the same factors as LOX systems, namely user preference for dilution versus nondilution and aircraft/man interface considerations. K.K.

A89-10461

CONSISTENCY ACROSS MEASURES OF SIMULATOR SICKNESS - IMPLICATIONS FOR A BIOCYBERNETIC SAFETY REPORTING DEVICE

ROBERT S. KENNEDY, DENNIS R. BALTZLEY (Essex Corp., Orlando, FL), MICHAEL G. LILIENTHAL (U.S. Navy, Naval Training Systems Center, Orlando, FL), GLENN O. ALLGOOD (Martin Marietta Corp., Oak Ridge, TN), and DANIEL W. GOWER (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, AL) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov.

16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 95-100. refs

More than 1000 US Navy and Marine Corps pilots were asked about the simulator sickness symptoms they experienced during hops in ground-based flight trainers; postural disequilibrium was measured as well. In addition, a motion history questionnaire was administered to the subjects in groups and generally away from the simulator site. The incidence percentage from the field survey was nearly 40 percent, while the percentage of simulator sickness incidence for the history survey was about 24 percent. It is suggested that a biocybernetic device installed permanently in a simulator could provide useful information in real time for human quality assurance of simulators and avoid problems which may be encountered when using retrospective measures for determining the actual frequency of simulator sickness incidence. K.K.

A89-10462

AIRCREW INTEGRATED SYSTEMS (AIS) PROGRAM

MARTY CLEMENT, BRIAN KNORR, and PETER HANLEY (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 109-112.

The objective of the aircrew integrated systems program is to develop an integrated life support system which provides the capabilities and protection required in combat environments. Capabilities include chemical biological protection, anti-g protection, anti-drown protection, and laser and nuclear flashblindness protection. The main objective of the AIS program is to have a prime system contractor develop and integrate all required protection and capabilities through a system design approach. The following aircraft are to be included in the first two stages of the program: the F-16, F-15, ATF, B-1B, B-2, MC-130H, and MH-53 H/J. K.K.

A89-10464

A NEW APPROACH TO HEAD AND NECK SUPPORT

ROBERT P. HUBBARD (Michigan State University, East Lansing) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 126-129.

New head and neck support (HANS) devices are being developed to reduce fatiguing or injurious neck loads, limit undesirable or extreme motions of the head relative to the torso, permit desirable head motions, and distribute the restraining loads of the shoulder harness on the torso. These HANS devices are described together with their function and development. With the HANS, the device provides a 'platform' on the torso for the tether forces to directly resist the motions of the head and to reduce neck loading. K.K.

A89-10465

THE PREDICTION OF HYBRID II MANIKIN HEAD-NECK KINEMATICS AND DYNAMICS

JACQUELINE PAVER and BARRON FISHBURNE (Duke University, Durham, NC) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 130-135. refs (Contract F49620-85-C-0013)

A data set of the Hybrid II manikin head-neck system was developed for the articulated total body model. The Part 572 Head-Neck Pendulum Compliance Test of the Code of Federal Regulations was simulated to validate this data set. Parameterizations were performed to assess the effects of changes in neck joint characteristics on the model responses. It was found that an increase in the head-neck linear flexural spring coefficient decreased the amplitude and period of the head rotation; it decreased the amplitude and increased the period of the chordal displacement. K.K.

A89-10467

ADAM - THE PHYSICAL BEING

RICHARD P. WHITE, JR. (Systems Research Laboratories, Inc.,

Dayton, OH) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 141-149. refs (Contract F33615-85-C-0535)

The development of an advanced dynamic anthropomorphic manikin (ADAM) to test the capabilities of the crew escape technologies ejection seat during emergency egress from an aircraft is described. It is noted that a damped/elastic spine provides an elastic degree of freedom between the upper torso and the pelvis in an attempt to simulate the elastic deformation of the human body in the vertical direction during dynamic Gz loading. ADAM's skeletal structure is described as well as its flesh coverings, joint design, and spine design. K.K.

A89-10468

COCKPIT AND EQUIPMENT INTEGRATION LABORATORY - MISSION, METHODOLOGY, AND ACTIVITIES

TRACY C. ORR, TODD T. VIKAN, RICHARD A. WHITE, and DURRELL BESS (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 150-154.

The Cockpit and Equipment Integration Laboratory (CEIL) has completed five years of operation. It has become the Air Force center of expertise in cockpit and equipment integration efforts. The mission, methodology, and activities of the CEIL are examined. Author

A89-10469

THE INTEGRATED CONCEPT FOR AIRCREW LIFE SUPPORT EQUIPMENT

TODD T. VIKAN, JOHN B. BOMAR, JR., and TRACY C. ORR (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 161-165.

General aircrew integration principles are developed on the basis of lessons learned during the testing and evaluation of integrated aircrew chemical defense respirators. The USAF School of Aerospace Medicine Cockpit and Equipment Integration Laboratory (CEIL) has been involved in the development and evaluation of six different aircrew chemical defense respirators. Three were designed using an 'integrated helmet concept (IHC)', and three were 'modular concept (MC)' respirators. It is found that the use of short eye relief optical and electrooptical devices with the IHC designs is much more difficult than with MC respirators. K.K.

A89-10470

ACCEPTIBILITY OF STANDARD USAF BREATHING GEAR AT HIGH ALTITUDE

RON D. HOLDEN, JOHN B. BOMAR, ROBERT B. O'CONNOR, C. S. WRIGHT (USAF, School of Aerospace Medicine, Brooks AFB, TX), and THOMAS E. NESTHUS (KRUG International Corp., Brooks AFB, TX) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 166-170.

Physiological issues relevant to the use of the MBU-12/P oxygen mask with the CRU-73/A diluter-demand regulator at high altitude are discussed. It is shown that well-trained subjects can successfully complete a one minute exposure to 50,000 ft after rapid decompression by using the standard USAF breathing system. The typical USAF system tested offered fairly good hypoxia protection to 43,000 ft. Above that altitude, there was less hypoxia protection. Pressure breathing levels of 45 to 50 mm Hg and a mask capable of sealing at 50-70 Hg are recommended at 50,000 ft. K.K.

A89-10472

OZONE CONTAMINANT TESTING OF A MOLECULAR SIEVE OXYGEN CONCENTRATOR (MSOC)

GEORGE W. MILLER (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: SAFE Association, Annual Symposium,

25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 176-182. USAF-supported research. refs

An attempt was made to determine if ozone, in concentrations found in the upper atmosphere, would penetrate the beds of a molecular sieve oxygen concentrator (MSOC) and enter the product or breathing gas. It is found that a molecular-sieve oxygen concentrator containing either an MG3 or 5AMG molecular sieve and subjected to the highest atmospheric ozone concentration will have a product ozone concentration significantly below the threshold limit value of 0.1 ppmv. Thus, aircrews will not experience any adverse physiological effects. Moreover, high levels of ozone had no effect on the oxygen enriching ability of the concentrator.

K.K.

A89-10473

INVESTIGATION OF AN AUTOMATICALLY ADJUSTABLE ENERGY ABSORBER

J. D. GLATZ (U.S. Navy, Naval Air Development Center, Warminster, PA) and JAMES C. WARRICK (Simula, Inc., Phoenix, AZ) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 183-189. Navy-FAA-supported research. refs

A program for investigating the performance of a developmental energy absorber system that passively adjusts to the occupant's weight is described. The acceleration-sensing automatic variable load energy absorber/fixed-load energy absorber (ASAVLEA/FLEA) system is described and compared to the variable-load energy absorber (VLEA) system. On the basis of the average stroking 'g' value, dynamic response index, Eiband injury probability, and total seat stroke, the ASAVLEA/FLEA system is found to provide comparable performance to the VLEA system.

K.K.

A89-10474

ENERGY ABSORBING SYSTEM DESIGN AND EVALUATION USING A DISCRETE ELEMENT MODEL OF THE SPINE

EBERHARDT PRIVITZER (Calspan Corp., Buffalo, NY) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 190-195. refs

The application of the head-spine model (HSM) to the design and evaluation of energy absorbing seats/systems is discussed. This approach is based on the use of a highly discretized mathematical model of the mechanical behavior of the human head-spine-torso structure. The crash attenuating performances of two types of vertically stroking helicopter seats were analyzed by comparing the HSM-spinal injury function and internal load predictions from simulations of high-G impact tests carried out with the seats. A model of an inverted tube-type energy absorber is described.

K.K.

A89-10477

SAFETY IN MAN-MACHINE INTERFACES

P. WETTERLIND (California State University, San Bernardino) and W. JOHNSTON (Texas A & M University, College Station) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 211-215. refs

Contemporary computer system interfaces are evaluated with particular attention given to teletype keyboards, keyboards with icons, and natural language processors as input devices. It is found that voice command input is preferable in stable and hazard-free situations, and that keyboards supplemented with icons on special function keys are best used in tedious environments when response times are important. Fully typed keyboard command entry is the most reliable method when error tolerances are at a minimum.

K.K.

A89-10479

THE DEVELOPMENT OF A INSTRUMENTED HUMAN LIKE PELVIS FOR INCORPORATION INTO STATE OF THE ART MANIKINS

GEORG D. FRISCH (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 224-229. refs

The engineering specifications, performance criteria, instrumentation capabilities, and sizing parameterization of a composite material pelvis designed to be retrofitted into Hybrid III manikins are described. It is shown that these pelvises are anthropometrically representative, exhibit the proper mass distribution properties, and are instrumented with both inertial and load sensors. This configuration allows for realistic occupant/seat system interaction. It is noted that data pertaining to injury parameters and probabilities can be provided.

K.K.

A89-10480

FLIGHT HELMETS - USER REQUIREMENTS AND HOW THEY ARE ACHIEVED

ROY W. GAMBLIN (Helmets, Ltd., Saint Albans, England) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 235-240.

It is shown that aircrew helmets must meet a wide range of requirements for protection, mission performance, and user acceptance. General helmet design is discussed as well as levels of performance, helmet weight, design conflict and compromise, and additional future problem areas. It is noted that, in the context of helmet-mounted devices, helmet system weight, bulk, stability, and center of gravity are of particular importance to the user.

K.K.

A89-10481

ALTITUDE CHAMBER TESTING OF A PARACHUTIST'S HIGH ALTITUDE OXYGEN SUPPLY (PHAOS) SYSTEM

MIKE RATAJCZAK (Carleton Technologies, Inc., East Aurora, NY) IN: SAFE Association, Annual Symposium, 25th, Las Vegas, NV, Nov. 16-19, 1987, Proceedings. Newhall, CA, SAFE Association, 1987, p. 243-248.

Altitude chamber tests were carried out on 44- and 120-cu in. PHAOS configurations to determine their durations for four jump profiles. The jump profiles involved both high-altitude high opening (HAHO) and high-altitude low opening (HALO) jumps with and without mild exercise. Oxygen supply pressure was recorded to ascertain the duration of the system during the jump. The mask pressure, inspired oxygen concentration, and total ventilation were also monitored to determine the breathing resistance and adequacy of the diluter demand regulator in the PHAOS oxygen mask. It is found that a supply of 86 cu in. of oxygen stored at 1800 psi is sufficient for the HAHO profile. The 44 cu in. supply configuration is adequate for HALO missions.

K.K.

A89-10492

AUTOMATION AND ROBOTICS IN SPACE [AUTOMATION UND ROBOTIK IM WELTRAUM]

E. FREUND (Dortmund, Universitaet, Federal Republic of Germany) IN: Yearbook 1987 I; DGLR, Annual Meeting, Berlin, Federal Republic of Germany, Oct. 5-7, 1987, Reports. Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1987, p. 54-60. In German. refs

(DGLR PAPER 87-096)

The current status of robotics for space applications is surveyed and illustrated with diagrams and drawings, and strategies for future R&D efforts are examined with reference to the FRG Planning Framework for High Technology and Space Flight (OHR). The design structure of a typical manipulator system is outlined; the degree of robot control needed for different space missions (ranging from telepresence and teleoperation to fully autonomous operation) is discussed; and the control-theoretical problem of trajectory determination for three robots and one work platform in free flight is briefly considered. The key technologies to be developed within

the OHR include lightweight intelligent sensor-guided manipulators, modular gripping systems and wide-application tools, improved man-machine interfaces, increased decision-making and planning capabilities via knowledge-based systems, and coordination of multiple-armed robots and multiple-robot configurations. T.K.

A89-10504

REGENERATIVE CO₂ FIXATION [REGENERATIVE CO₂-BINDUNG]

H. PREISS, H. FUNKE, and W. BREITLING (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) IN: Yearbook 1987 I; DGLR, Annual Meeting, Berlin, Federal Republic of Germany, Oct. 5-7, 1987, Reports. Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1987, p. 129-134. In German. BMFT-supported research. (DGLR PAPER 87-116)

The current status of regenerative CO₂-fixation systems being developed with DFVLR and ESA support for long-term use on the International Space Station is surveyed. The CO₂-fixation requirements for a crew of three are outlined; the criteria considered in selecting an ion-exchange-resin solid amine system over cold traps, liquid adsorbers, molecular sieves, and electrochemical cells are indicated; and the results of adsorption, desorption, stability, and cyclic operation tests on a prototype system are presented in extensive graphs and discussed in detail. T.K.

A89-10576

AEROSPACE BEHAVIORAL ENGINEERING TECHNOLOGY CONFERENCE, 6TH, LONG BEACH, CA, OCT. 5-8, 1987, PROCEEDINGS

Conference sponsored by SAE, Warrendale, PA, Society of Automotive Engineers, Inc. (SAE P-200), 1988, 418 p. For individual items see A89-10577 to A89-10600. (SAE P-200)

The proceedings discuss topics on human behavioral technology, simulation tasks, and flight operations that include work load, crew fitness, voice technology, commercial transport, image quality and electronic display, on-board systems for enhancing pilot situation awareness, advanced displays, cockpit automation, and the capabilities and requirements of the simulation of space operations. Papers are presented on pilot workload prediction, current military/government applications for speech recognition, image quality and visual simulation of color matrix displays, and physiological adaptation in space. Consideration is also given to the effects of video and symbology dynamics on pilot performance, a status report on the FAA low-visibility simulation, Langley Research Center resources and needs for manned space operations simulation, space simulation using computer generated imagery, fly-by-wire sidestick controller evaluation, and the airline pilots' view of interfacing with new technology in the modern flight deck. I.S.

A89-10583

AIR TRANSPORT CREW TASKING IN AN ATC DATA LINK ENVIRONMENT

JOHN L. GROCE and GEORGE P. BOUCEK, JR. (Boeing Commercial Airplane Co., Seattle, WA) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 59-68. (SAE PAPER 871764)

This paper discusses the results of a time-line analysis of air transport crew tasking using the Mode-S data link for ATC communications. The results indicate that the selected implementation of Mode-S data link based on a traditional control-and-display unit (CDU) concept in conventional and advanced flight decks may be acceptable during periods of low crew activity level (e.g., in the cruise phase of flight). However, it was found that, during high workload phases of flight, the substantial pilot visual tasking increases resulting from a CDU implementation could create vision channel overloads. It is recommended that alternative means of data link crew interface (e.g., speech technology) should be considered, to offload the

vision channels. Other specific recommendations offered concern the CDU configuration, graphic display of clearances, and autopilot interface. I.S.

A89-10586

EFFECTS OF FLAT-PANEL PIXEL STRUCTURES UPON THREE HUMAN PERFORMANCE MEASURES OF IMAGE QUALITY

NOVIA WEIMAN and ROBERT J. BEATON (Tektronix, Inc., Beaverton, OR) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 83-90. refs (SAE PAPER 871893)

The effect of pixel structure on the quality of graphical text displayed on flat panel systems was investigated in three human-performance experiments conducted using a simulator based on a CRT monitor. The results of the experiments demonstrated an asymmetric effect of horizontal and vertical pixel width and separation upon several different measures of image quality. It was shown that pixel structure is undetectable with horizontal fundamental spatial frequency components greater than 6.68 cycles/mm and vertical spatial frequency components greater than 4.0 cycles/mm. This effect was replicated using a subjective image-quality-rating and character-legibility-performance procedures. The asymmetry effect was shown to be caused by the structure of the characters used in the experiments, suggesting certain visual principles that should be used in the design of high-quality display systems. I.S.

A89-10588

WORKLOAD AND SITUATION AWARENESS IN FUTURE AIRCRAFT

TERRY J. EMERSON, JOHN M. REISING, and HAROLD G. BRITTEN-AUSTIN (USAF, Wright-Patterson AFB, OH) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 107-114. refs (SAE PAPER 871803)

This paper discusses the concept of including a workload prediction algorithm for the fast-time prediction, real-time measurement, and dynamic allocation of cockpit workload in an aircraft that is piloted by a crew of two: the human pilot and an electronic crewmember (EC). The real-time measurements will be based on a mixture of physiological and performance measurement techniques such as eye blinking rate, heart rate, evoked cortical potentials, and the analysis of voice stress. The EC will be aware of the complexity and demands of the current task and the performance of the pilot, and, if the pilot approaches his workload limit, will reallocate tasks and offer advice and assistance; should the pilot lose consciousness, the EC will take total control of the aircraft. I.S.

A89-10589

TEAS - AN AI BASED THREAT RESPONSE RECOMMENDATION SYSTEM

KEITH DRAKE and STEVE ROTHSTEIN (USAF, Wright-Patterson AFB, OH) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 115-120. refs (SAE PAPER 871804)

In the future fighter combat environment, the pilot will be faced with increased workload as he is forced to integrate various on-board sensor, weapons, and other aircraft systems. Specifically, he has less time to react to incoming missiles because of increased missile and aircraft speeds. The Air Force's Threat Expert Analysis System (TEAS) will determine and recommend threat responses to the pilot using all available resources. The system will do much of the data integration for the pilot, thereby reducing his workload. This paper reviews the approach being taken in the TEAS program development. Author

A89-10590**THE PILOT'S ASSOCIATE - ENHANCING SITUATIONAL AWARENESS THROUGH COOPERATING EXPERT SYSTEMS**

DOUGLAS M. ROUSE and THOMAS C. HUMMEL (USAF, Wright-Patterson AFB, OH) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 121-125. refs

(SAE PAPER 871896)

A new concept developed for the cockpit information management, the Pilot's Associate (PA), is discussed. The PA is a network of cooperating expert systems designed to enhance the situational awareness of the pilot by assisting the pilot with information management and aircraft control. The five systems composing the PA network include the Mission Planner, Tactics Planner, Situation Assessment, System Status, and Pilot-Vehicle Interface systems. Besides by converting and reducing data into essential prioritized information in a timely fashion and communicating this information to the pilot, the PA will also analyze the information and advise the pilot on recommended courses of action, enhancing his situational awareness and helping him to make better decisions. I.S.

A89-10591**AUTONOMOUS LANDING GUIDANCE CONCEPT - THE EFFECTS OF VIDEO AND SYMBOLOGY DYNAMICS ON PILOT PERFORMANCE**

TERESA L. MANN (Lockheed Aeronautical Systems Co., Marietta, GA) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 131-138. refs

(SAE PAPER 872390)

The concept of all-weather autonomous landing and guidance (ALG) capability of a tactical and transport aircraft is discussed together with the video and symbology dynamics requirements of the ALG concept. In a study using a six-degree-of-freedom motion base simulator, the requirements concerning the data update, sensor system resolution, and INS were evaluated, with variable image update rates, system resolution parameters and INS lateral offsets as independent variables. The pilot's task consisted of flying a simulated aircraft in a conventional 3-deg glideslope approach, with the conventional symbology presented on the HUD and the real world on the out-the-window visual scene. The work-load evaluation data were obtained in terms of a subjective work-load assessment technique and physiological parameters. Results are discussed in terms of main effects on pilot's performance. I.S.

A89-10592**FLIGHT DECK AUTOMATION TODAY - WHERE DO WE GO FROM HERE?**

ROLF BRAUNE and DELMAR M. FADDEN (Boeing Commercial Airplane Co., Seattle, WA) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 141-149. refs

(SAE PAPER 871823)

The existing guidelines in the areas of general philosophy, global recommendations, design analysis methods, and human-performance in the flight-deck automation are examined together with criteria for the flight-deck automation acceptance by the pilot. It is concluded that, while flight-deck automation technologies are helpful, the pilot cannot be replaced by machines in the foreseeable future, because many environmental situations, such as ever-changing weather and the ATC environment, will probably never be adequately preprogrammable, and the pilot will be needed to deal with unforeseen situations and abnormalities. I.S.

A89-10593**SHOULD TECHNOLOGY ASSIST OR REPLACE THE PILOT?**

S. R. LAST (International Federation of Air Line Pilots Associations,

Egham, England) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 151-155.

(SAE PAPER 880774)

This paper presents a survey of computer technology applications in transport aircraft and examines the direction and impact of automation on the flight deck. In particular, an attempt is made to answer the question of whether or not the automation technology is leading the way for the development of pilotless aircraft. It is suggested that, if the human pilot is to remain in control of aircraft operations, there are some trends in the design of both hardware and software which need modification and/or reversal. These trends are discussed. I.S.

A89-10594**SPAR (CANADA) CAPABILITIES - SIMULATION OF REMOTE MANIPULATOR OPERATIONS**

P. S. MATTHEWS and A. LUBORSKY (Spar Aerospace, Ltd., Remote Manipulator Systems Div., Toronto, Canada) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 165-179.

(SAE PAPER 871715)

The design principles of Canada's real-time Remote Manipulator Simulation Facility (SIMFAC), built to support the Shuttle Remote Manipulator System (RMS), and the SIMFAC's subsystem and software are discussed along with the results of studies performed using the facility. Operating characteristics of the SIMFAC involve a 23-degree-of-freedom mathematical model, with results displayed as simultaneous, real-time CRT monitor images of out-of-window and end-of-arm closed-circuit TV scenes. A non-real-time simulation program, based on a more detailed mathematical model and actual flight data, is used to validate the simulation. The paper also describes the characteristics of the next-generation general-purpose simulation facility, the Manipulator and Simulation Facility, that is being developed. Configuration diagrams and block diagrams are presented. I.S.

A89-10599**INTERFACING WITH NEW TECHNOLOGY IN THE MODERN FLIGHT DECK - THE AIRLINE PILOTS' VIEW**

E. P. FARRELL (International Federation of Air Line Pilots Associations, Egham, England) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 237-241.

(SAE PAPER 872391)

The application of new technology to the coming new generation of aircraft is causing the pilot community concern. The introduction of EFCS, the removal of control surface feedbacks to the control column, the removal of the physical interconnection between control columns, autothrottle thrust levers which are static, and CRT symbology are all subjects threatening the pilot-machine interface. Author

A89-10600**COMMUNICATIONS - THE INSIDE TRACK IN RESOURCE MANAGEMENT**

J. J. SPEYER and A. P. FORT (Airbus Industrie, Blagnac, France) IN: Aerospace Behavioral Engineering Technology Conference, 6th, Long Beach, CA, Oct. 5-8, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 245-259. refs

(SAE PAPER 871889)

This paper describes the results of a statistical analysis of the functional and behavioral task-communication patterns obtained from videotaped flights of three crews (with 15 flights analyzed out of 50 total), together with the details of the analytical procedure. The analysis made it possible to differentiate among the crew resource management styles and to define the style that was most effective in terms of clear communications that delineated the roles and responsibilities of each crew member. I.S.

A89-10645

DEVELOPING EFFECTIVE HUMAN ENGINEERING STANDARDS FOR COLOR FLIGHT DISPLAYS

DELMAR M. FADDEN and ALAN R. JACOBSEN (Boeing Commercial Airplane Co., Seattle, WA) IN: International Pacific Air and Space Technology Conference, Melbourne, Australia, Nov. 13-17, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 217-223. (SAE PAPER 872424)

Consideration is given to the color display Aerospace Recommended Practice, ARP-4032, now undergoing final approval by the SAE. It is noted that ARP 4032 represents a significant improvement in the documentation of useful human engineering data. Working with operationally defined requirements for effective displays, a subcommittee of the SAE G-10 (Aerospace Behavior Engineering Technology) committee has developed an ARP which translates the operational objectives outlined by the pilot community into specific functional requirements and test procedures which can be used by engineers to assure that color CRT displays perform properly under all operational conditions. B.J.

A89-10700

ANALYZING CONTROLLER TASKS TO DEFINE AIR TRAFFIC CONTROL SYSTEM AUTOMATION REQUIREMENTS

MARK D. PHILLIPS and BRIAN E. MELVILLE (Computer Technology Associates, Inc., Colorado Springs, CO) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 37-44. refs (Contract DOT-FA01-85-Y-01034) (SAE PAPER 872515)

This paper describes a task analysis-based methodology developed to support the requirements specification, design, and operational suitability evaluation of the next generation Air Traffic Control (ATC) system. A sample ATC scenario is used to show the relationship between the task analysis methodology, system-level function allocations, and user-system interface (USI) design. Task networks and characterizations based on an aircraft-to-airspace conflict situation under two different function allocation schemes are described. Methods of using the task analysis to guide USI design decisions are presented, along with several candidate USI designs developed using these criteria.

Author

A89-10701

TOTAL SCOPE OF HAZARD ANALYSES

JOYCE A. MCDEVITT (ORI, Inc., Alexandria, VA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 45-51. refs (SAE PAPER 872516)

The typical application of hazard analyses during the system acquisition life cycle is addressed to provide an insight into the system safety efforts intended to minimize the possibility of human error during system operation. An inventory of the state-of-the-art techniques used in hazard analyses is presented, and the implication for human error prevention is discussed for those techniques which are most frequently used in aerospace system safety programs. Author

A89-10702

MODELLING SYSTEM DESIGN COMPONENTS OF PILOT ERROR

ROBERT O. BESCO (Professional Performance Improvement Corp., Lakewood, CA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 53-57. refs (SAE PAPER 872517)

A five-factor model to identify the causes of pilot error has been developed from a review of civilian aircraft accidents. The model is based on the assumption that errors have a cause and can be prevented by removing error-inducing elements from all

five factors. The model involves a sequential analysis of the inducing elements and their associated reducers. Emphasis will be placed in this paper on the system design factors as an inducer of pilot errors. Each causative element is paired with a preventative element to suggest techniques for minimizing risks. Author

A89-10703

A 'NEWCOMER'S' PERSPECTIVE ON SYSTEM ERROR PREVENTION IN OPERATIONAL TEST AND EVALUATION

PATRICK T. CAHALANE (USAF, Operational Test and Evaluation Center, Kirtland AFB, NM) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 59, 60. (SAE PAPER 872521)

The current status of system error prevention in Air Force operational test and evaluation is briefly reviewed. Activities in this field consist of early identification of system errors that have the potential to adversely affect mission accomplishment and provision of recommendations for corrective action. System errors in an operational environment are currently identified by using primarily qualitative methods. The importance of developing an operationally usable objective approach in the assessment of in-flight performance and workload is emphasized. V.L.

A89-10704

SOFTWARE SYSTEMS SAFETY AND HUMAN ERROR AVOIDANCE

MICHAEL L. BROWN (U. S. Navy, Naval Surface Warfare Center, Dahlgren, VA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 61-70. refs (SAE PAPER 872522)

The software systems safety issue is discussed with reference to various areas of human errors that can affect the operation of a system. Standard software systems safety analyses are reviewed, with attention given to the concept of safety critical computer software components, requirements traceability matrix, software requirements hazards analysis, top level design hazards analysis, detailed design hazards analysis, and code level hazards analysis. Attention is also given to software safety testing, software/user interface analysis, software change hazard analysis, and tool validation. The need for an early integrated approach to both software systems safety and human factors is emphasized. V.L.

A89-10705

ADVANCED TECHNOLOGY COCKPIT DESIGN AND THE MANAGEMENT OF HUMAN ERROR

ROGER D. HOUCK, WILLIAM H. ROGERS, and ROLF J. BRAUNE (Boeing Commercial Airplane Co., Seattle, WA) IN: Human Error Avoidance Techniques Conference, Washington, DC, Dec. 1-3, 1987, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1988, p. 71-77. refs (SAE PAPER 872525)

The differences between systematic (design or procedure induced) and random pilot error and the implications of these classes of errors for the cockpit design process are discussed. It is argued that systematic errors can be reduced through better design and procedures, while random error must be controlled and managed through error tolerant design. It is further noted that both these design solutions can best be realized by a pilot-centered approach, with automation designed to support the pilot in the piloting task by adhering to guidelines such as simplification, increased situation awareness, and appropriate allocation of the function. V.L.

A89-11682*# Case Western Reserve Univ., Cleveland, Ohio.

ROBOTS FOR MANIPULATION IN A MICRO-GRAVITY ENVIRONMENT

R. D. QUINN (Case Western Reserve University, Cleveland, OH) and C. LAWRENCE (NASA, Lewis Research Center, Cleveland, OH) IN: Dynamics and control of large structures; Proceedings

of the Sixth VPI&SU/AIAA Symposium, Blacksburg, VA, June 29-July 1, 1987. Blacksburg, VA, Virginia Polytechnic Institute and State University, 1988, p. 515-528. refs

This paper is concerned with the development of control strategies and mechanisms for robots operating in the micro-gravity environment of Space Station. These robots must be capable of conducting experiments and manufacturing processes without disturbing the micro-gravity environment through base reactions/motions. Approaches discussed for controlling the robot base reactions/motions include strategies making use of manipulators with redundant degrees of freedom, actuators at the robot base, and a redundant (balancing) arm. Two degree-of-freedom, traction-drive joints are discussed as well as the conceptual design for a traction-driven manipulator. Author

A89-11812

SENSOR INTEGRATION BY SYSTEM AND OPERATOR

DEWEY RUNDUS (South Florida, University, Tampa, FL) IN: Space Station automation III; Proceedings of the Meeting, Cambridge, MA, Nov. 2-4, 1987. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 64-68. refs

Maintenance of proper functioning of the Space Station will require monitoring of a large number of sensors. This task will include not only state monitoring, but also the need to recognize trends which might lead to fault states. Both types of monitoring would be aided if groups of sensor values could be reduced to a single value which preserved their important characteristics. Multidimensional scaling is proposed as a technique to achieve such a goal. This approach, in addition to being useful in the creation of aids to a human operator, would also have characteristics which would make it a useful sensor integration approach for automated systems. Author

A89-11816* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TELEROBOT EXPERIMENT CONCEPTS IN SPACE

LYLE M. JENKINS (NASA, Johnson Space Center, Houston, TX) IN: Space Station automation III; Proceedings of the Meeting, Cambridge, MA, Nov. 2-4, 1987. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 92-94.

A unique set of problems will be encountered in the development of telerobotic systems for space applications such as the Flight Telerobotic System. The dexterous manipulation of objects in zero g will be significantly different. Issues arise from mechanical response and operator interaction with the controls and displays. To reduce development risk, a series of experiments are conceived for the Space Shuttle. Author

A89-11913

KNOWLEDGE-BASED PREHENSION - CAPTURING HUMAN DEXTERITY

THEA IBERALL, JOE JACKSON, LIZ LABBE, and RALPH ZAMPANO (Hartford Graduate Center, CT) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 1. Washington, DC, Computer Society Press, 1988, p. 82-87. refs

A major question facing the development of sophisticated robotics systems is how to capture the functionality seen in versatile living systems. An approach that has proven useful in designing complex systems is to capture the explicit constraints in a knowledge-based system. A knowledge-based planning system under development is reported which attempts to capture the versatility of human prehension. The goal is to model the relationship between perceptual and motor systems in human prehension as well as to develop a knowledge-based grasp planner able to control sophisticated, dextrous robot hands. I.E.

A89-11915

CHOPSTICK MANIPULATION WITH AN ARTICULATED HAND - A QUALITATIVE ANALYSIS

G. WANG and H. E. STEPHANOU (George Mason University, Fairfax, VA) IN: 1988 IEEE International Conference on Robotics

and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 1. Washington, DC, Computer Society Press, 1988, p. 94-99. refs

The kinematics, static force propagation, and stability of tool manipulation by an articulated hand are analyzed. The manipulation of chopsticks is used as a case study to illustrate some fundamental characteristics of tool manipulation. A qualitative requirements analysis for chopstick manipulation is outlined. Emphasis is placed on the characteristics of objects and grasps in fine manipulation. I.E.

A89-11982* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EXPERIMENTAL AND SIMULATION STUDIES OF HARD CONTACT IN FORCE REFLECTING TELEOPERATION

BLAKE HANNAFORD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) and ROBERT ANDERSON (Illinois, University, Urbana) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 1. Washington, DC, Computer Society Press, 1988, p. 584-589. refs

Experiments and simulations of a single-axis force-reflecting teleoperation system have been conducted to investigate the problem of contacting a hard environment and maintaining a controlled force in teleoperation in which position is fed forward from the hand controller (master) to the manipulator (slave), and force is fed back to the human operator through motors in the master. The simulations, using an electrical circuit model, reproduce the behavior of the real system, including effects of human operator biomechanics. It is shown that human operator properties, which vary as a result of different types of grasp of the handle, affect the stability of the system in the hard-contact task. The effect of a heavier grasp on the handle is equivalent to increased hand-controller velocity damping in terms of the systems stability in the contact task, but control system damping sufficient to guarantee stable contact results in perceptible sluggishness of the control handle's response in free motion. These results suggest that human operator biomechanics must be taken into account to guarantee stable and ergonomic performance of advanced teleoperators. I.E.

A89-11983* California Univ., Berkeley.

COOPERATIVE CONTROL IN TELEROBOTICS

LAWRENCE W. STARK, WON S. KIM, and FRANK TENDICK (California, University, Berkeley) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 1. Washington, DC, Computer Society Press, 1988, p. 593-595. NASA-supported research.

It is argued that autonomous robotics is not yet feasible, and that instantaneous human control may be difficult because of communication delay and expensive because of labor costs. Therefore, it is argued, human supervisory control with cooperation between man and a partially autonomous distant robot is the most viable engineering solution. Model control of image processing enables efficient visual displays. Cooperative control in paired manipulators required rapid controller signal information to be passed over a cross-filter in a heuristic study. I.E.

A89-12039

A VISION SYSTEM FOR SAFE ROBOT OPERATION

PEN-SHU YEH, STEVE BARASH, and EDWARD WYSOCKI (Martin Marietta Laboratories, Baltimore, MD) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 3. Washington, DC, Computer Society Press, 1988, p. 1461-1465. refs

A robotic vision system capable of detecting intruders and abnormalities in a gantry robot work space has been constructed to ensure the safe operation of the robot. The system uses two CCD video cameras mounted on the frame of the gantry for monitoring the work space and a novel four-point ranging algorithm for determining the relationship between the camera reference frame and the robot base frame. Intruder/abnormality location is found through a triangulation scheme based on features extracted

from the two camera images. Without compensating for lens distortion, accuracy achieved for locating intruders is between 1/60 to 1/100 of depth. I.E.

A89-12065* Rice Univ., Houston, Tex.
**FUSION OF RADAR AND OPTICAL SENSORS FOR SPACE
 ROBOTIC VISION**

SCOTT W. SHAW, RUI J. P. DEFIGUEIREDO, and KUMAR KRISHNEN (Rice University, Houston, TX) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 3. Washington, DC, Computer Society Press, 1988, p. 1842-1846. refs (Contract NGT-44-006-806)

Returned radar power estimates are used in an iterative procedure which generates successive approximations to the target shape in order to determine the shape of a 3-D surface. A simulation is shown which involves the reconstruction of an edge of a flat plate. Although this is a somewhat artificial example, it addresses the real problem of recovering edges of space objects lost in shadow or against a dark background. The results indicate that a microwave/optical sensor fusion system is possible, given sufficient computing power and accurate radar cross section measuring systems. I.E.

A89-12069*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

AUTOMATED ORBITAL RENDEZVOUS CONSIDERATIONS
 ROBERT N. LEA (NASA, Johnson Space Center, Houston, TX) IN: 1988 IEEE International Conference on Robotics and Automation, Philadelphia, PA, Apr. 24-29, 1988, Proceedings. Volume 3. Washington, DC, Computer Society Press, 1988, p. 1871, 1872. refs

The control of the rendezvous vehicle during proximity operations is considered. It is shown how fuzzy sets can be used for autonomous vehicle control to model the human capability of common sense reasoning. Such models are integrated with expert systems and engineering control systems technology to create a system that performs comparably to a manned system. I.E.

A89-12601* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**STATIC STEREO VISION DEPTH DISTORTIONS IN
 TELEOPERATION**

D. B. DINER and M. VON SYDOW (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Ergonomics of hybrid automated systems I. Amsterdam, Elsevier Science Publishers, 1988, p. 227-232.

A major problem in high-precision teleoperation is the high-resolution presentation of depth information. Stereo television has so far proved to be only a partial solution, due to an inherent trade-off among depth resolution, depth distortion and the alignment of the stereo image pair. Converged cameras can guarantee image alignment but suffer significant depth distortion when configured for high depth resolution. Moving the stereo camera rig to scan the work space further distorts depth. The 'dynamic' (camera-motion induced) depth distortion problem was solved by Diner and Von Sydow (1987), who have quantified the 'static' (camera-configuration induced) depth distortion. In this paper, a stereo image presentation technique which yields aligned images, high depth resolution and low depth distortion is demonstrated, thus solving the trade-off problem. Author

N89-10088*# California Univ., Berkeley. Telerobotics Unit.

A UNIVERSITY TEACHING SIMULATION FACILITY
 LAWRENCE STARK, WON-SOO KIM, FRANK TENDICK, MITCHELL TYLER, BLAKE HANNAFORD, WISSAM BARAKAT, OLAF BERGENGRUEN, LOUIS BRADDI, JOSEPH EISENBERG, STEPHEN ELLIS et al. IN NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 30 p 1987
 Avail: NTIS HC A99/MF E03 CSCL 05H

An experimental telerobotics (TR) simulation is described suitable for studying human operator (HO) performance. Simple

manipulator pick-and-place and tracking tasks allowed quantitative comparison of a number of calligraphic display viewing conditions. A number of control modes could be compared in this TR simulation, including displacement, rate, and acceleratory control using position and force joysticks. A homeomorphic controller turned out to be no better than joysticks; the adaptive properties of the HO can apparently permit quite good control over a variety of controller configurations and control modes. Training by optimal control example seemed helpful in preliminary experiments.

Author

N89-10089*# Grumman Aerospace Corp., Bethpage, N.Y.
**OPEN CONTROL/DISPLAY SYSTEM FOR A TELEROBOTICS
 WORK STATION**

SAUL KESLOWITZ IN NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 21 p 1987
 Avail: NTIS HC A99/MF E03 CSCL 05H

A working Advanced Space Cockpit was developed that integrated advanced control and display devices into a state-of-the-art multimicroprocessor hardware configuration, using window graphics and running under an object-oriented, multitasking real-time operating system environment. This Open Control/Display System supports the idea that the operator should be able to interactively monitor, select, control, and display information about many payloads aboard the Space Station using sets of I/O devices with a single, software-reconfigurable workstation. This is done while maintaining system consistency, yet the system is completely open to accept new additions and advances in hardware and software. The Advanced Space Cockpit, linked to Grumman's Hybrid Computing Facility and Large Amplitude Space Simulator (LASS), was used to test the Open Control/Display System via full-scale simulation of the following tasks: telerobotic truss assembly, RCS and thermal bus servicing, CMG changeout, RMS constrained motion and space constructible radiator assembly, HPA coordinated control, and OMV docking and tumbling satellite retrieval. The proposed man-machine interface standard discussed has evolved through many iterations of the tasks, and is based on feedback from NASA and Air Force personnel who performed those tasks in the LASS. Author

N89-10090*# Human Machine Interfaces, Inc., Knoxville, Tenn. Fuel Recycle Div.

**CONSOLIDATED FUEL REPROCESSING PROGRAM: THE
 IMPLICATIONS OF FORCE REFLECTION FOR
 TELEOPERATION IN SPACE**

JOHN V. DRAPER, JOSEPH N. HERNDON, and WENDY E. MOORE IN NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 16 p 1987 Previously announced as N87-27402 Prepared in cooperation with Martin Marietta Aerospace, Denver, Colo.
 (Contract DE-AC05-84OR-21400)

Avail: NTIS HC A99/MF E03 CSCL 05H

Previous research on teleoperator force feedback is reviewed and results of a testing program which assessed the impact of force reflection on teleoperator task performance are reported. Force reflection is a type of force feedback in which the forces acting on the remote portion of the teleoperator are displayed to the operator by back-driving the master controller. The testing program compared three force reflection levels: 4 to 1 (four units of force on the slave produce one unit of force at the master controller), 1 to 1, and infinity to 1 (no force reflection). Time required to complete tasks, rate of occurrence of errors, the maximum force applied to tasks components, and variability in forces applied to components during completion of representative remote handling tasks were used as dependent variables. Operators exhibited lower error rates, lower peak forces, and more consistent application of forces using force reflection than they did without it. These data support the hypothesis that force reflection provides useful information for teleoperator users. The earlier literature and the results of the experiment are discussed in terms of their implications for space based teleoperator systems. The

discussion described the impact of force reflection on task completion performance and task strategies, as suggested by the literature. It is important to understand the trade-offs involved in using telerobotic systems with and without force reflection.

Author

N89-10091*# Martin Marietta Aerospace, Denver, Colo.
ISSUES, CONCERNS, AND INITIAL IMPLEMENTATION RESULTS FOR SPACE BASED TELEROBOTIC CONTROL

D. A. LAWRENCE, J. D. CHAPEL, and T. M. DEPKOVICH /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 18 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

Telerobotic control for space based assembly and servicing tasks presents many problems in system design. Traditional force reflection teleoperation schemes are not well suited to this application, and the approaches to compliance control via computer algorithms have yet to see significant testing and comparison. These observations are discussed in detail, as well as the concerns they raise for imminent design and testing of space robotic systems. As an example of the detailed technical work yet to be done before such systems can be specified, a particular approach to providing manipulator compliance is examined experimentally and through modeling and analysis. This yields some initial insight into the limitations and design trade-offs for this class of manipulator control schemes. Implications of this investigation for space based telerobots are discussed in detail.

Author

N89-10092*# RCA Advanced Technology Labs., Moorestown, N.J.

A SHARED POSITION/FORCE CONTROL METHODOLOGY FOR TELEOPERATION

JIN S. LEE /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 12 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

A flexible and computationally efficient shared position/force control concept and its implementation in the Robot Control C Library (RCCL) are presented from the point of teleoperation. This methodology enables certain degrees of freedom to be position-controlled through real time manual inputs and the remaining degrees of freedom to be force-controlled by computer. Functionally, it is a hybrid control scheme in that certain degrees of freedom are designated to be under position control, and the remaining degrees of freedom to be under force control. However, the methodology is also a shared control scheme because some degrees of freedom can be put under manual control and the other degrees of freedom put under computer control. Unlike other hybrid control schemes, which process position and force commands independently, this scheme provides a force control loop built on top of a position control inner loop. This feature minimizes the computational burden and increases disturbance rejection. A simple implementation is achieved partly because the joint control servos that are part of most robots can be used to provide the position control inner loop. Along with this control scheme, several menus were implemented for the convenience of the user. The implemented control scheme was successfully demonstrated for the tasks of hinged-panel opening and peg-in-hole insertion.

Author

N89-10093*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

MULTIPLE SENSOR SMART ROBOT HAND WITH FORCE CONTROL

RICHARD R. KILLION, LEE R. ROBINSON, and ANTAL BEJCZY /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 20 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

A smart robot hand developed at JPL for the Protoflight Manipulator Arm (PFMA) is described. The development of this smart hand was based on an integrated design and subsystem

architecture by considering mechanism, electronics, sensing, control, display, and operator interface in an integrated design approach. The mechanical details of this smart hand and the overall subsystem are described elsewhere. The sensing and electronics components of the JPL/PFMA smart hand are summarized and it is described in some detail in control capabilities.

Author

N89-10094*# McDonnell-Douglas Astronautics Co., Houston, Tex. Engineering Services.

AN OPTIMAL RESOLVED RATE LAW FOR KINEMATICALLY REDUNDANT MANIPULATORS

B. J. BOURGEOIS /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 20 p 1987 Previously announced as N88-17268

Avail: NTIS HC A99/MF E03 CSCL 05H

The resolved rate law for a manipulator provides the instantaneous joint rates required to satisfy a given instantaneous hand motion. When the joint space has more degrees of freedom than the task space, the manipulator is kinematically redundant and the kinematic rate equations are underdetermined. These equations can be locally optimized, but the resulting pseudo-inverse solution was found to cause large joint rates in some case. A weighting matrix in the locally optimized (pseudo-inverse) solution is dynamically adjusted to control the joint motion as desired. Joint reach limit avoidance is demonstrated in a kinematically redundant planar arm model. The treatment is applicable to redundant manipulators with any number of revolute joints and to nonplanar manipulators.

Author

N89-10095*# Maryland Univ., College Park. Robotics Lab.

AN ADAPTIVE CONTROL SCHEME FOR A FLEXIBLE MANIPULATOR

T. C. YANG, J. C. S. YANG, and P. KUDVA (Advanced Technology and Research, Inc., Burtonsville, Md.) /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 14 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

The problem of controlling a single link flexible manipulator is considered. A self-tuning adaptive control scheme is proposed which consists of a least squares on-line parameter identification of an equivalent linear model followed by a tuning of the gains of a pole placement controller using the parameter estimates. Since the initial parameter values for this model are assumed unknown, the use of arbitrarily chosen initial parameter estimates in the adaptive controller would result in undesirable transient effects. Hence, the initial stage control is carried out with a PID controller. Once the identified parameters have converged, control is transferred to the adaptive controller. Naturally, the relevant issues in this scheme are tests for parameter convergence and minimization of overshoots during control switch-over. To demonstrate the effectiveness of the proposed scheme, simulation results are presented with an analytical nonlinear dynamic model of a single link flexible manipulator.

Author

N89-10098*# Oak Ridge National Lab., Tenn. Center for Engineering Systems Advanced Research.

DYNAMIC TASK ALLOCATION FOR A MAN-MACHINE SYMBIOTIC SYSTEM

L. E. PARKER and F. G. PIN /in NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 19 p 1987 Previously announced as N87-30070 Submitted for publication

(Contract DE-AC05-84OR-21400)

Avail: NTIS HC A99/MF E03 CSCL 05H

This report presents a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This report addresses a symbiotic system containing two symbiotic partners which work toward controlling a single manipulator arm for the execution of a series of sequential manipulation tasks. It is proposed

that an automated task allocator use knowledge about the constraints/criteria of the problem, the available resources, the tasks to be performed, and the environment to dynamically allocate task recommendations for the man and the machine. The presentation of the methodology includes discussions concerning the interaction of the knowledge areas, the flow of control, the necessary communication links, and the replanning of the task allocation. Examples of task allocation are presented to illustrate the results of this methodology. DOE

N89-10101*# Martin Marietta Aerospace, Denver, Colo. Advance Automation Technology (Robotics) Group.

ACTUATORS FOR A SPACE MANIPULATOR

W. CHUN and P. BRUNSON *In* NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 20 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

The robotic manipulator can be decomposed into distinct subsystems. One particular area of interest of mechanical subsystems is electromechanical actuators (or drives). A drive is defined as a motor with an appropriate transmission. An overview is given of existing, as well as state-of-the-art drive systems. The scope is limited to space applications. A design philosophy and adequate requirements are the initial steps in designing a space-qualified actuator. The focus is on the d-c motor in conjunction with several types of transmissions (harmonic, tendon, traction, and gear systems). The various transmissions will be evaluated and key performance parameters will be addressed in detail. Included in the assessment is a shuttle RMS joint and a MSFC drive of the Prototype Manipulator Arm. Compound joints are also investigated. Space imposes a set of requirements for designing a high-performance drive assembly. Its inaccessibility and cryogenic conditions warrant special considerations. Some guidelines concerning these conditions are present. The goal is to gain a better understanding in designing a space actuator.

Author

N89-10102*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CABLE APPLICATIONS IN ROBOT COMPLIANT DEVICES

JAMES J. KERLEY *In its* Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 11 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

Robotic systems need compliance to connect the robot to the work object. The cable system illustrated offers compliance for mating but can be changed in space to become quite stiff. Thus the same system can do both tasks, even in environments where the work object or robot are moving at different frequencies and different amplitudes. The adjustment can be made in all six degrees of freedom, translated in or rotated in any plane and still make a good contact and control.

Author

N89-10104*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TELEOPERATED POSITION CONTROL OF A PUMA ROBOT

EDMUND AUSTIN and CHUNG P. FONG *In* NASA, Goddard Space Flight Center, Proceedings of 1987 Goddard Conference on Space Applications of Artificial Intelligence (AI) and Robotics 19 p 1987

Avail: NTIS HC A99/MF E03 CSCL 05H

A laboratory distributed computer control teleoperator system is developed to support NASA's future space telerobotic operation. This teleoperator system uses a universal force-reflecting hand controller in the local site as the operator's input device. In the remote site, a PUMA controller receives the Cartesian position commands and implements PID control laws to position the PUMA robot. The local site uses two microprocessors while the remote site uses three. The processors communicate with each other through shared memory. The PUMA robot controller was interfaced through custom made electronics to bypass VAL. The development status of this teleoperator system is reported. The execution time

of each processor is analyzed, and the overall system throughput rate is reported. Methods to improve the efficiency and performance are discussed. Author

N89-10522*# National Aeronautics and Space Administration, Washington, D.C.

LIVING IN SPACE, BOOK 2, LEVELS D, E, F

SHEILA BRISKIN ANDREWS and AUDREY KIRSCHENBAUM 1987 70 p Original document contains color illustrations (NASA-EP-223; NAS 1.19:223) Avail: SOD HC \$4.75 as 033-000-01001; NTIS MF A01 CSCL 06K

In June 1984, President Reagan announced a new NASA program, Operation Liftoff. For more than 25 years NASA has pioneered on the cutting edge of science and technology and has stimulated our young people to strive for excellence in all they do. This program is designed to encourage pupils in the nation's elementary schools to take a greater interest in mathematics and science. Areas addressed include: food, clothing, health, housing, communication, and working in space. B.G.

N89-10523# Illinois Univ., Urbana. Dept. of Physics.

PRESSURE STUDIES OF PROTEIN DYNAMICS Annual Report, 1 Mar. 1987 - 26 Feb. 1988

HANS FRAUENFELDER and ROBERT D. YOUNG 26 Feb. 1988 20 p

(Contract N00014-86-K-0270; RR0-4106)

(AD-A192386) Avail: NTIS HC A03/MF A01 CSCL 06A

In this research we extend and deepen our studies of the relation between dynamic structure and function in proteins. We study protein dynamics using flash photolysis together with near ultraviolet, visible, and near and mid-infrared spectroscopies over wide ranges in time (50 ns to 10 ks), temperature (60 to 320 K), and pressure (0.1 to 100 MPa). Initially we study a simple biomolecular reaction -- carbon monoxide (CO) binding to myoglobin (Mb). We have greatly expanded knowledge of pressure effects on proteins by using the infrared CO stretching frequencies in MbCO as a probe. The combined pressure and temperature studies shed new light on various features of the hierarchical model of protein substates and motions. These studies also provide much information on the glass like behavior of proteins, including the slaved glass transition and glass-like relaxation processes near the transition temperature. GRA

N89-11389# National Highway Traffic Safety Administration, East Liberty, Ohio. Vehicle Research and Test Center.

EVALUATION OF THE PROTOTYPE EUROSID DUMMY AND COMPARISON WITH THE US SID (SIDE IMPACT DUMMIES) Final Report, Nov. 1986 - Mar. 1987

ROGER A. SAUL Sep. 1987 121 p

(PB88-201934; DOT-HS-807-219) Avail: NTIS HC A06/MF A01 CSCL 05H

As part of their side impact protection programs, the United States and Europe have developed side impact dummies (SID). The dummies differ in many areas including principal thoracic measurement technique. The report describes the National Highway Traffic Safety Administration testing of the EUROSID model to determine its repeatability, durability, biofidelity, and its ability to assess potential injury reduction countermeasures, as contrasted with the U.S. SID. Specific procedures and results of component qualification tests and HYGE sled tests as well as dummy instrumentation procedures are described. GRA

N89-11390 Purdue Univ., West Lafayette, Ind.

CONTROL DESIGN AND PERFORMANCE EVALUATION FOR FLEXIBLE MANIPULATORS Ph.D. Thesis

KIYOHARU MATSUOKA 1987 204 p

Avail: Univ. Microfilms Order No. DA8807644

To date, many manipulator designs have been based on rigid body considerations. These designs are often characterized by stiff structures and sluggish responses, while flexible manipulator designs are recognized for such benefits as energy-efficiency and maneuverability. The increasing demands for more accurate modeling of the flexible manipulators result in larger and more

complex nonlinear models with more degrees of freedom. For realistic problems, the required algebra becomes prohibitive and error-prone by paper and pencil. Symbolic processing of nonlinear equations of motion, based on Lagrange formulation and the assumed-modes method, was employed extensively. Since a flexible structure is a distributed-parameter system, any finite-dimensional attempt to control such a system is not free from the ill-effects of intrinsic model errors. A suboptimal gain scheduling scheme with model error accommodation to control flexible manipulators is presented. For the performance evaluation of a control design, a nonlinear closed-loop simulation should be carried out under realistic model error environments. Simplification of such evaluation process by combined use of a simulation language and a properly interfaced symbolic manipulation system is discussed. The effectiveness of both the model-error accommodating control and the performance evaluation process is demonstrated by an example. Dissert. Abstr.

N89-11391 Stanford Univ., Calif.

EXPERIMENTS IN CONTROL OF SATELLITE MANIPULATORS
Ph.D. Thesis

HAROLD LUCHSINGER ALEXANDER 1988 116 p

Avail: Univ. Microfilms Order No. DA8808343

A new method is presented for space robot control that is based on the operational-space or resolved-acceleration method developed for industrial style manipulators. The new extended version makes allowance for the dynamic reaction of the freely-floating robot body when the manipulator is moved, so that precise specified end-effector accelerations in space may be achieved in spite of the lack of a fixed manipulator base. A mathematical dynamic model is developed for the laboratory robot and the extended control method is experimentally applied to the robot with command of straight-line slews between points fixed in inertial space. Successful trajectory tracking and position regulation are demonstrated independent of the orientation of the command reference frame with respect to the free-floating robot body. The potential of the extended operational space method for non-manipulator control applications is discussed. The extension to three-dimensional space robot control is introduced as well as applications involving multi-manipulator robots and multiple robots. The stability of model-based control methods such as operational space and computed torque is discussed. Dissert. Abstr.

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N89-11392# Academy of Sciences of the Ukrainian SSR, Kharkov.
Inst. Radiofiziki i Ehlektroniki.

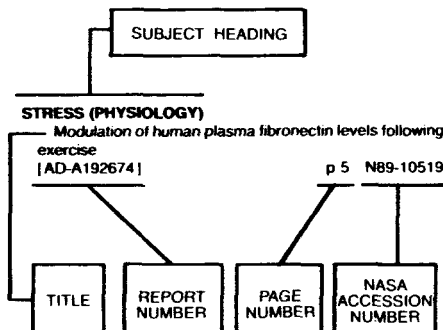
PROBABLE LOCATIONS OF EXTRATERRESTRIAL CIVILIZATIONS

A. V. ARKHIPOV 1986 14 p In RUSSIAN; ENGLISH summary

(DE88-702605; INIS-SU-25/A) Avail: NTIS (US Sales Only) HC A03/MF A01

The search for extraterrestrial civilizations by monitoring their continuous isotropic radio emissions at frequencies from 100 to 1000 MHz is discussed. Such a possibility has been found at a distance of approximately 20 pc in this frequency range. The search for similar radio sources continues. The discoveries are in the vicinity of four solar-type stars, which would be favorable for the existence intelligent life. The probability of error in this case would be 2×10 to the minus 4 power. These four stars are the most promising SETI sources to date. DOE

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, a title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page 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. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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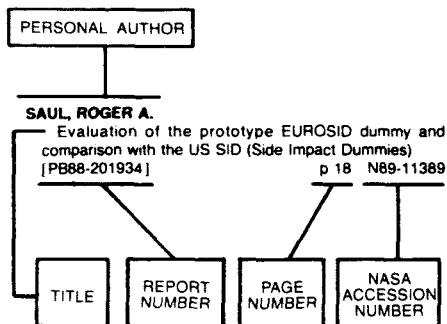
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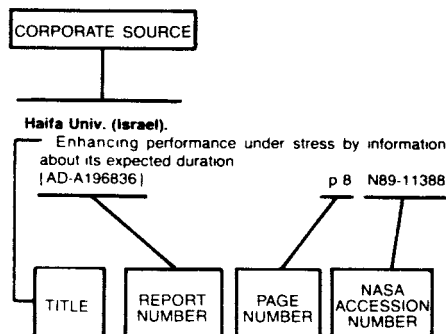
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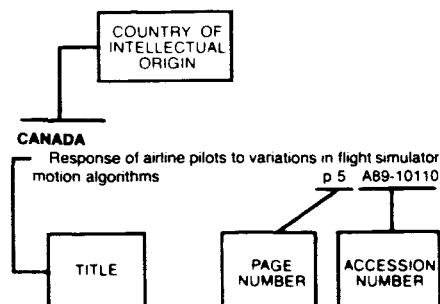
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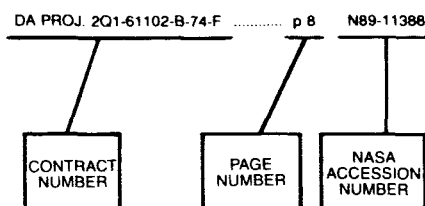
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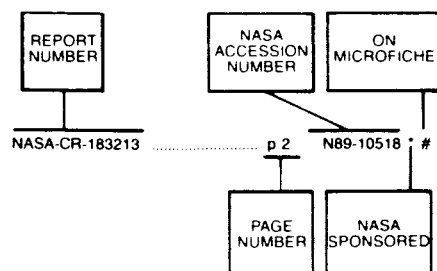
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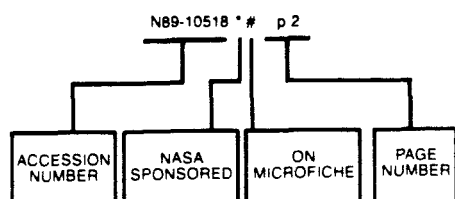
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				6. Performing Organization Code	
7. Author(s)				8. Performing Organization Report No.	
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, DC 20546				10. Work Unit No.	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address				13. Type of Report and Period Covered	
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15. Supplementary Notes					
16. Abstract This bibliography lists 125 reports, articles and other documents introduced into the NASA scientific and technical information system in January, 1989.					
17. Key Words (Suggested by Authors(s)) Aerospace Medicine Bibliographies Biological Effects				18. Distribution Statement Unclassified - Unlimited	
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