



Aerospace Medicine  
and Biology  
A Continuing  
Bibliography  
with Indexes

NASA SP-101 (3-79)  
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National Aeronautics and  
Space Administration

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Aerospace Medicine and Biology

# **AEROSPACE MEDICINE AND BIOLOGY**

**A CONTINUING BIBLIOGRAPHY  
WITH INDEXES**

**(Supplement 338)**

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 June 1990 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

1990

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# INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 139 reports, articles and other documents announced during June 1990 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 1990 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  
ON MICROFICHE  
CORPORATE SOURCE

ACCESSION NUMBER → N90-10571\*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

TITLE → A SIMPLE, MASS BALANCE MODEL OF CARBON FLOW IN A CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM

AUTHOR AND PUBLICATION DATE → JAY L. GARLAND Mar. 1989 37 p Prepared in cooperation with Bionetics Corp., Cocoa Beach, FL

CONTRACT NUMBER → (Contract NAS10-10285)

REPORT NUMBERS → (NASA-TM-102151; NAS 1.15:102151) Avail: NTIS HC A03/MF A01

COSATI CODE → CSCL 05/8

← AVAILABILITY SOURCE  
← PRICE CODE

Internal cycling of chemical elements is a fundamental aspect of a Controlled Ecological Life Support System (CELSS). Mathematical models are useful tools for evaluating fluxes and reservoirs of elements associated with potential CELSS configurations. A simple mass balance model of carbon flow in CELSS was developed based on data from the CELSS Breadboard project at Kennedy Space Center. All carbon reservoirs and fluxes were calculated based on steady state conditions and modelled using linear, donor-controlled transfer coefficients. The linear expression of photosynthetic flux was replaced with Michaelis-Menten kinetics based on dynamical analysis of the model which found that the latter produced more adequate model output. Sensitivity analysis of the model indicated that accurate determination of the maximum rate of gross primary production is critical to the development of an accurate model of carbon flow. Atmospheric carbon dioxide was particularly sensitive to changes in photosynthetic rate. The small reservoir of CO<sub>2</sub> relative to large CO<sub>2</sub> fluxes increases the potential for volatility in CO<sub>2</sub> concentration. Feedback control mechanisms regulating CO<sub>2</sub> concentration will probably be necessary in a CELSS to reduce this system instability.

Author

# TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED  
CORPORATE SOURCE

ACCESSION NUMBER → A90-11091\* Krug International, San Antonio, TX.

TITLE → DETERMINING A BENDS-PREVENTING PRESSURE FOR A SPACE SUIT

AUTHORS → R. W. KRUTZ, JR., J. T. WEBB (Krug International, Technology Services Div., San Antonio, TX), and G. A. DIXON (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAFE Journal, vol. 19, Fall 1989, p. 20-24. Research sponsored by USAF. refs

PUBLICATION DATE → (Contract NASA ORDER T-82170) Copyright

← AUTHORS' AFFILIATION  
← JOURNAL TITLE

Research conducted to determine the proper pressure for preventing bends during EVA without preoxygenation is examined. Male and female subjects with different breathing gas mixtures and pressures are studied in order to define the pressure. Visual and auditory Doppler ultrasonic signals are utilized to monitor intravascular gas bubbles. The workload, which simulates EVA, consists of a handturned bicycle ergometer, a torque wrench operation, and a rope pull. The experimental data reveal that the minimum space suit pressure needed to prevent decompression sickness is 9.5 psi.

I.F.

# AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 338)

JULY 1990

51

## LIFE SCIENCES (GENERAL)

**A90-28084\*** Mount Sinai School of Medicine, New York, NY.  
**A GEOMETRIC ANALYSIS OF SEMICIRCULAR CANALS AND INDUCED ACTIVITY IN THEIR PERIPHERAL AFFERENTS IN THE RHESUS MONKEY**

H. REISINE (Mount Sinai School of Medicine, New York; Zuerich, Universitaet, Zurich, Switzerland), J. I. SIMPSON (New York University, NY), and V. HENN (Zuerich, Universitaet, Zurich, Switzerland) New York Academy of Sciences, Annals (ISSN 0077-8923), vol. 545, Dec. 26, 1988, p. 10-20. Research supported by the EMDO Foundation and Eidgenoessische Technische Hochschule Zuerich. refs  
(Contract SNSF-3,718,80; NAG3-336; NIH-NS-13742)  
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Experiments were carried out to determine anatomically the planes of the semicircular canals of two juvenile rhesus monkeys, using plastic casts of the semicircular canals, and the anatomical measurements were related to the directional coding of neural signals transmitted by primary afferents innervating the same semicircular canals. In the experiments, animals were prepared for monitoring the eye position by the implantation of silver-silver chloride electrodes into the bony orbit. Following the recording of semicircular canal afferent activity, the animals were sacrificed; plastic casting resin was injected into the bony canals; and, when the temporal bone was demineralized and removed, the coordinates of points spaced along the circumference of the canal casts were measured. A comparison of the sensitivity vectors determined in these experiments and the anatomical measures showed that the average difference between a sensitivity vector and its respective normal vector was 6.3 deg. I.S.

**A90-29024**  
**EFFECT OF HIGH-ALTITUDE HYPOXIA ON THE PULMONARY BLOOD CIRCULATION IN RATS [VLIIANIE VYSOKOGORNOI GIPOKSII NA KROVOBRASHCHENIE V MALOM KRUGE U KRYS]**

B. I. MAZHBICH, K. S. UMAROV, A. KH. SHANDAULOV, O. M. RAZUMNIKOVA, and E. T. KOZHAMKULOV (AMN SSSR, Institut Fiziologii, Novosibirsk, USSR; Kirgizskii Gosudarstvennyi Meditsinskii Institut, Frunze, Kirgiz SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Dec. 1989, p. 1718-1724. In Russian. refs  
Copyright

The effect of high-altitude hypoxia on the hemodynamics of the pulmonary circulation was investigated in rats maintained for 3 to 300 days at the altitude of 3200 m above sea level. Within a few days after being transferred to this altitude, an increase of the systolic pressure in the pulmonary artery was recorded, while the diastolic pressure remained unchanged. An elevated hemoglobin content in erythrocytes, accompanied by an increase of the erythrocyte size (while the erythrocyte number did no change), accounted for the increased oxygen capacity of arterial

blood. There was also a steady decrease in body weight, starting as early as the 3rd day of the experiment. I.S.

**A90-29025**  
**CHARACTERISTICS OF THE PORPHYRIN EXCHANGE AND ERYTHRON INDICES IN RATS UNDER COMBINED EFFECTS OF PHYSICAL EXERCISE AND HIGH TEMPERATURE [OB OSOBNOSTIAKH PORFIRINOVOGO OBMENA I POKAZATELEI ERITRONA V USLOVIAKH SOCHETANNOGO VOZDEISTVIA TEPLOVOI I FIZICHESKOI NAGRUZOK NA ORGANIZM KRYS]**

L. V. VORGOVA and I. M. ZAKHAROV (Cheliabinskii Gosudarstvennyi Meditsinskii Institut, Chelyabinsk, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Dec. 1989, p. 1772-1777. In Russian. refs  
Copyright

**A90-29597\*** Louisville Univ., KY.  
**AGE EFFECTS ON RAT HINDLIMB MUSCLE ATROPHY DURING SUSPENSION UNLOADING**

JOSEPH M. STEFFEN, RONALD D. FELL, THOMAS E. GEOGHEGAN, LISA C. RINGEL, and X. J. MUSACCHIA (Louisville, University, KY) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, March 1990, p. 927-931. Research supported by NSF. refs  
(Contract NAG2-386; NASA ORDER A-53745-C)  
Copyright

The effects of hindlimb unloading on muscle mass and biochemical responses were examined and compared in adult (450-g) and juvenile (200-g) rats after 1, 7, or 14 days of whole-body suspension. Quantitatively and qualitatively the soleus, gastrocnemius, plantaris, and extensor digitorum longus (EDL) muscles of the hindlimb exhibited a differential sensitivity to suspension and weightlessness unloading in both adults and juveniles. The red slow-twitch soleus exhibited the most pronounced atrophy under both conditions, with juvenile responses being greater than adult. In contrast, the fast-twitch EDL hypertrophied during suspension and atrophied during weightlessness, with no significant difference between adults and juveniles. Determination of biochemical parameters (total protein, RNA, and DNA) indicates a less rapid rate of response in adult muscles. Author

**A90-30283**  
**THE SKELETAL SYSTEM AND WEIGHTLESSNESS [KOSTNAIA SISTEMA I NEVESOMOST']**

GURII P. STUPAKOV and ALEKSANDR I. VOLOZHIN Moscow, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Volume 63), 1989, 185 p. In Russian. refs  
Copyright

Data are presented on the bone tissue alterations caused in humans and laboratory animals by an exposure to reduced gravity, either during a space flight or under experimental conditions of reduced hindlimb load or hypodynamia. Based on experiments in animals, mineral changes in various parts of the skeleton, due to the unloading effect, are summarized together with changes in mechanical properties of the bones affected by unloading. Special attention is given to the benefits of the application of artificial-gravity (centrifugal acceleration) in space in maintaining the condition of the bone tissue, as well as to the modeling of the bone-tissue

## 51 LIFE SCIENCES (GENERAL)

atrophy caused by weightlessness. An equation is derived relating the atrophy rate of a particular bone to the bone index and the loss of Ca from this bone within a given period. I.S.

**A90-30585\*** Kansas State Univ., Manhattan.

**TEST OF THE ANTIORTHOSTATIC SUSPENSION MODEL ON MICE - EFFECTS ON THE INFLAMMATORY CELL RESPONSE**  
CHARLES F. ROSENKRANS, JR., STEPHEN K. CHAPES, and SHERRY D. FLEMING (Kansas State University, Manhattan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 327-332. Research supported by the Wesley Foundation. refs  
(Contract NAGW-1197; NIH-CA-40477)  
Copyright

The antiorthostatic suspension model was tested for use as a 1G model to study the effects of factors that will be encountered during space travel on inflammation. No differences were found in inflammatory cells induced in antiorthostatically suspended mice. However, the superoxide response (used for oxidative killing of bacteria such as *S. aureus*) was impaired in antiorthostatically oriented mice compared to control mice. Elevated corticosterone levels were found in antiorthostatically suspended mice, indicating that stress may be a factor in the model. If the stress factor of the model correlates with the physiological stress of space flight, antiorthostatic suspension may be an acceptable model for studying inflammatory responses in mice. Author

**A90-30615\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ESTIMATES OF THE MAXIMUM TIME REQUIRED TO ORIGINATE LIFE**

VERNE R. OBERBECK (NASA, Ames Research Center, Moffett Field, CA) and GUY FOGLEMAN (SETI Institute, Moffett Field, CA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 549-560. refs  
Copyright

Fossils of the oldest microorganisms exist in 3.5 billion year old rocks and there is indirect evidence that life may have existed 3.8 billion years ago (3.8 Ga). Impacts able to destroy life or interrupt prebiotic chemistry may have occurred after 3.5 Ga. If large impactors vaporized the oceans, sterilized the planets, and interfered with the origination of life, life must have originated in the time interval between these impacts which increased with geologic time. Therefore, the maximum time required for the origination of life is the time that occurred between sterilizing impacts just before 3.8 Ga or 3.5 Ga, depending upon when life first appeared on earth. If life first originated 3.5 Ga, and impacts with kinetic energies between  $2 \times 10^{24}$  to the  $34^{\text{th}}$  and  $2 \times 10^{25}$  to the  $35^{\text{th}}$  were able to vaporize the oceans, using the most probable impact flux, it is found that the maximum time required to originate life would have been 67 to 133 million years (My). If life originated 3.8 Ga, the maximum time to originate life was 2.5 to 11 My. Using a more conservative estimate for the flux of impacting objects before 3.8 Ga, a maximum time of 25 My was found for the same range of impactor kinetic energies. The impact model suggests that it is possible that life may have originated more than once. Author

**A90-30617\*** California Univ., La Jolla.

**MIXED-VALENCE HYDROXIDES AS BIOORGANIC HOST MINERALS**

K. KUMA, W. PAPLAWSKY, B. GEDULIN, and G. ARRHENIUS (California, University, La Jolla) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 573-601. refs  
(Contract NAGW-1031; NSF EAR-87-21219)  
Copyright

A range of naturally occurring divalent-trivalent metal cation hydroxides and modified artificial analogs have been synthesized and characterized. Structural and chemical properties of these minerals, determining their capability to selectively concentrate, order and alter molecules of prebiotic interest, include their anion exchange capacity and specificity, photochemical reactivity,

production of nascent hydrogen, and catalytic efficiency. Properties relevant to these functions have been investigated and are discussed. Author

**A90-30618**

**CHEMICAL EVOLUTION OF THE CITRIC ACID CYCLE - SUNLIGHT AND ULTRAVIOLET PHOTOLYSIS OF CYCLE INTERMEDIATES**

THOMAS G. WADDELL, SUNIL K. GEEVARGHESE, BARRY S. HENDERSON (Tennessee, University, Chattanooga), RICHARD M. PAGNI, and JESSICA S. NEWTON (Tennessee, University, Knoxville) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 603-607. Research supported by U.C. Foundation-Grote Chemistry Funds. refs  
Copyright

Sunlight or laboratory ultraviolet photolyses of oxalacetic, succinic, fumaric, malic and citric acids were carried out on 0.1 M aqueous solutions. The nonvolatile products were isolated and identified by GC-MS analysis of derived methyl esters. Several conversions corresponding to modern citric acid cycle reactions were observed. Notably, oxalacetic acid gave citric as the major product of sunlight photolysis. Other identified products relate to chemical evolution and further support the important role of succinic acid in the origin of life. Author

**A90-30619\*** Rensselaer Polytechnic Inst., Troy, NY.

**OLIGOMERIZATION REACTIONS OF DEOXYRIBONUCLEOTIDES ON MONTMORILLONITE CLAY - THE EFFECT OF MONONUCLEOTIDE STRUCTURE ON PHOSPHODIESTER BOND FORMATION**

JAMES P. FERRIS and MR. KAMALUDDIN (Rensselaer Polytechnic Institute, Troy, NY) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 609-619. refs  
(Contract NSF CHE-85-06377; NGR-33-018-148)  
Copyright

The formation of oligomers from deoxynucleotides, catalyzed by Na(+)-montmorillonite, was investigated with special attention given to the effect of the monomer structure on the phosphodiester bond formation. It was found that adenine deoxynucleotides bind more strongly to montmorillonite than do the corresponding ribonucleotides and thymidine nucleotides. Tetramers of 2-prime-dpA were detected in the reaction of 2-prime-d-5-prime-AMP with a water-soluble carbodiimide EDAC in the presence of Na(+)-montmorillonite, illustrating the possible role of minerals in the formation of biopolymers on the primitive earth. I.S.

**A90-30620**

**THE DISTRIBUTION OF AMINO ACIDS IN THE GENETIC CODE**

LIAO FU LUO (Nei Monggol University, Hohhot, People's Republic of China) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 621-631. Research supported by the National Natural Science Foundation of China. refs  
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By introducing a mutational deterioration function and a principle of approximate minimum of the function, the distribution of amino acids in genetic code is deduced. Consideration is given to the degeneracy rule of codons, the global extreme of genetic code form codon interactions, and the hydrophobicity domain of the prevalent (standard) code. Author

**A90-30621**

**SELF-REPLICATING MICELLES - A CHEMICAL VERSION OF A MINIMAL AUTOPOIETIC SYSTEM**

PIER LUIGI LUISI (Zuerich, Eidgenossische Technische Hochschule, Zurich, Switzerland) and FRANCISCO J. VARELA (Ecole Polytechnique, Paris, France) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 633-643. Research supported by the Fondation de France and Prince Trust Fund. refs  
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Reverse micelles hosting the internal production of the surfactant are proposed as experimentally feasible models of simple (or 'minimal') autopoietic systems. The conditions under which these may be formed are described together with their possible biological implications. The micellar systems considered here turn out also to exhibit a capacity for self-reproduction through fragmentation under plausible conditions, thus constituting also a minimal experimental model for prebiotic self-reproduction.

Author

**N90-18852\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**THREE-DIMENSIONAL COCULTURE PROCESS Patent**

**Application**

DAVID A. WOLF, inventor (to NASA) and THOMAS J. GOODWIN, inventor (to NASA) (Krug International, Houston, TX.) 2 Mar. 1989 27 p

(NASA-CASE-MS-C-21560-1; NAS 1.71:MSC-21560-1; US-PATENT-APPL-SN-317931) Avail: NTIS HC A03/MF A01 CSCL 06C

The present invention relates to a 3-dimensional co-culture process, more particularly to methods or co-culturing at least two types of cells in a culture environment, either in space or in unit gravity, with minimum shear stress, freedom for 3-dimensional spatial orientation of the suspended particles and localization of particles with differing or similar sedimentation properties in a similar spatial region to form 3-dimensional tissue-like structures. Several examples of multicellular 3-dimensional experiences are included. The protocol and procedure are also set forth. The process allows simultaneous culture of multiple cell types and supporting substrates in a manner which does not disrupt the 3-dimensional spatial orientation of these components. The co-cultured cells cause a mutual induction effect which mimics the natural hormonal signals and cell interactions found in the intact organism. This causes the tissues to differentiate and form higher 3-dimensional structures such as glands, junctional complexes, polypoid geometries, and microvilli which represent the corresponding in-vitro structures to a greater degree than when the cell types are cultured individually or by conventional processes. This process was clearly demonstrated for the case of two epithelial derived colon cancer lines, each co-cultured with normal human fibroblasts and with microcarrier bead substrates. The results clearly demonstrate increased 3-dimensional tissue-like structure and biochemical evidence of an increased differentiation state. With the present invention a variety of cells may be co-cultured to produce tissue which has 3-dimensionality and has some of the characteristics of in-vitro tissue. The process provides enhanced 3-dimensional tissue which create a multicellular organoid differentiation model.

NASA

**N90-18853\*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

**CONTINUOUS HYDROPONIC WHEAT PRODUCTION USING A RECIRCULATING SYSTEM**

C. L. MACKOWIAK, L. P. OWENS, C. R. HINKLE (Bionetics Corp., Cocoa Beach, FL.), and R. P. PRINCE Sep. 1989 58 p (Contract NAS10-10285)

(NASA-TM-102784; NAS 1.15:102784) Avail: NTIS HC A04/MF A01 CSCL 02C

Continuous crop production, where plants of various ages are growing simultaneously in a single recirculating nutrient solution, is a possible alternative to batch production in a Controlled Ecological Life Support System. A study was conducted at John F. Kennedy Space Center where 8 trays (0.24 sq m per tray) of *Triticum aestivum* L. Yecora Rojo were grown simultaneously in a growth chamber at 23 C, 65 percent relative humidity, 1000 ppm CO<sub>2</sub>, continuous light, with a continuous flow, thin film nutrient delivery system. The same modified Hoagland nutrient solution was recirculated through the plant trays from an 80 L reservoir throughout the study. It was maintained by periodic addition of water and nutrients based on chemical analyses of the solution. The study was conducted for 216 days, during which 24 trays of wheat were consecutively planted (one every 9 days), 16 of which

were grown to maturity and harvested. The remaining 8 trays were harvested on day 216. Grain yields averaged 520 g m<sup>-2</sup> (exp -2), and had an average edible biomass of 32 percent. Consecutive yields were unaffected by nutrient solution age. It was concluded that continual wheat production will work in this system over an extended period of time. Certain micronutrient deficiencies and toxicities posed problems and must be addressed in future continuous production systems.

Author

**N90-19736#** London Univ. (England). Toxicology Unit.

**STUDY OF HYDRAZINE METABOLISM AND TOXICITY Annual Report No. 1, 15 Sep. 1988 - 14 Sep. 1989**

J. A. TIMBRELL 13 Nov. 1989 36 p

(Contract AF-AFOSR-0313-88; AF PROJ. 2301)

(AD-A217103; EOARD-TR-90-013) Avail: NTIS HC A03/MF A01 CSCL 02/5

The research project studying hydrazine in rats has revealed the following: (1) The uptake of hydrazine into the liver may be a saturable process; (2) After a hepatotoxic dose of hydrazine the concentration in the liver is about 0.2mM; (3) Some hydrazine remains in the liver 24 hours after a single dose at a level higher than the plasma level; (4) At the highest dose level (81mg/kg) rats lost weight over the following 4 days and liver weight was decreased. At a dose of 27mg/kg, the liver weight was elevated 4 days after the single dose; (5) The rats given the highest dose still showed fatty liver 4 days after dosing. Rats given lower doses also showed some vacuolation in hepatocytes; (6) Determination of hydrazine and acetylhydrazine in urine after various single doses showed a dose dependent decrease in acetylation; (7) NMR revealed a number of metabolites: unchanged hydrazine, acetyl and diacetylhydrazine, hydrazones with pyruvate and 2-oxogitarate, urea and ammonia; (8) Studies in hepatocytes have shown that hydrazine is cytotoxic at concentrations of 16mM and above; (9) Hepatocyte studies have also shown that 8mM hydrazine depletes ATP and glutathione; and (10) Preliminary studies in microsomes have shown that hydrazine is metabolised by a cytochrome P450 dependent system. Chemical breakdown and other enzymic breakdown are also involved however.

GRA

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### AEROSPACE MEDICINE

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

**A90-28074\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**FLOW MEASUREMENTS IN A MODEL OF THE MILDLY CURVED FEMORAL ARTERY OF MAN**

L. H. BACK, E. Y. KWACK (JPL, Pasadena, CA), and D. W. CRAWFORD (Southern California, University, Los Angeles, CA) IN: Blood flow in large arteries: Applications to atherogenesis and clinical medicine. Basel, Switzerland, S. Karger, 1990, p. 96-108. refs

(Contract NIH-HL-23619-05)

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The effects of curvature on the flow rate near the wall in the vicinity of the mildly curved femoral artery of man, and on the pressure distributions along the curved segment, were investigated using glass and tygon flow models constructed to conform to the shape of the femoral angiogram of a human subject. The test fluid was 33 percent aqueous sucrose. Steady flow observations, made using a dye flow visualization system, revealed a flow pattern like that observed in coiled pipes. A double helical type flow was found to develop, with converging streamlines in the wall vicinity from the upper and lower plane of curvature merging asymptotically along the inner curvature in a stable manner. Pressure measurements for steady flow revealed progressively larger

pressure drops with distance along the entrance region of the curved segment, relative to that for a straight lumen. I.S.

A90-28834

**VECTOR CARDIOGRAPH EXPERIMENT IN SPACE SHUTTLE**

S. R. NAGARAJ and R. K. RAJANGAM (ISRO, Satellite Centre, Bangalore, India) IN: ITC/USA/'89; Proceedings of the International Telemetering Conference, San Diego, CA, Oct. 30-Nov. 2, 1989. Research Triangle Park, NC, Instrument Society of America, 1989, p. 113-123.

Copyright

The vector cardiography (VCG) instrument for three-dimensional electrocardiographic study was developed to monitor the cardiac responses of the Indian payload specialist who was to have flown aboard the Space Shuttle during the Insat-1C mission. Signals from various points of the payload specialist's body were picked up by eight sensors connected to the VCG amplifier unit. After processing, the signals obtained were amplified and rectified to drive a bargraph display module. O.C.

A90-29076

**CHARACTERISTICS OF TRACE PROCESSES IN DIFFERENT REGIONS OF THE HUMAN CORTEX [OSOBENNOSTI SLEDOVYKH PROTSESSOV V RAZLICHNYKH OBLASTIAKH KORY GOLOVNOGO MOZGA CHELOVEKA]**

E. S. OPOLINSKII and L. A. ROZHKOVA (Akademiia Pedagogicheskikh Nauk SSSR, Nauchno-Issledovatel'skii Institut Defektologii, Moscow, USSR) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 72-80. In Russian. refs Copyright

The dynamics of evoked potentials (EPs) in different regions of the human cortex and the dependence of the EP dynamics on the attentiveness of the subject were investigated in experiments in which subjects were presented with a sequence of sound signals. Two conditions were compared: (1) full attentiveness, when subjects were asked to count the number of signals; and (2) distracted attentiveness, when subjects were asked to read a book. It was found that the dynamics of the amplitude-time parameters of auditory EPs, and its alterations, depended on the level of activation of the central nervous system (CNS). The characteristics of the EP patterns for the temporal regions of the left and the right hemispheres obtained under the two conditions of attentiveness are compared, and the results are discussed in the framework of neurophysiological mechanisms of trace formation in the CNS. I.S.

A90-29077

**EFFECT OF ADAPTATION TO INTERMITTENT HYPOXIA ON THE TOLERANCE OF UNTRAINED HUMANS TO PHYSICAL EXERCISE, AND IDIOPATHIC HEART ARRHYTHMIAS [VLIANIE ADAPTATSII K PERIODICHESKOI GIPOKSII NA TOLERANTNOST' NETRENIROVANNYKH LIUDEI K FIZICHESKOI NAGRUZKE I IDIOPATICHESKIE ARITMI SERDTSA]**

F. Z. MEERSON, V. M. BOEV, IA. I. KOTS, V. P. TVERDOKHLIB, V. S. GRIGOREVSKIKH (AMN SSSR, Nauchno-Issledovatel'skii Institut Obshchei Patologii i Patologicheskoi Fiziologii, Moscow; Orenburgskii Gosudarstvennyi Meditsinskii Institut, Orenburg, USSR) et al. Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 94-105. In Russian. refs Copyright

Results are presented on the effect of adaptation to hypoxia on the physical work capacity of healthy humans and of subjects suffering from attacks of cardiac neurosis and idiopathic arrhythmia. It was found that, in healthy humans untrained with regard to physical exercise, the adaptation to intermittent hypoxia in a pressure chamber (3.5 hours at an altitude which was increased daily from 1.5 to 3.0 km for five days and then was left at the 3.0-3.5 km level for 18-20 more sessions) led to an increase in work capacity and more efficient circulation and respiration. Adaptation to hypoxia was also beneficial for subjects with neurasthenia and idiopathic arrhythmia. Moreover, treatments by

exposure to hypoxia were found to cause decreases of blood atherogenicity, blood cholesterol, and body weight. I.S.

A90-29078

**ASSESSING THE BLOOD CIRCULATION SYSTEM FUNCTION DURING EXPOSURE TO ERGOTHERMIC LOADS [OTSENKA FUNKTSII SISTEMY KROVOOBRAZHENIYA PRI ERGOTERMICHESKIKH VOZDEISTVIYAKH]**

A. N. BUKHARIN and N. N. PLAKHOV Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 106-111. In Russian. refs

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The blood circulation system function in humans performing physical exercises at high temperature (150 min daily at 42 C for 5 days or 120 for 7 days) was assessed by measuring the indices of integral total-body rheography and of leg rheovasography. Changes recorded during the adaptation to high temperature indicate that the key element in the mechanisms responsible for both the adaptation to ergothermal stress and the pathological shifts occurring during the stress exposure is the condition of the body microcirculation, which is responsible for changes in the redox processes in muscles, causing decreases in energy exchange. I.S.

A90-29079

**ORTHOSTATIC STABILITY OF A HEALTHY HUMAN DURING HYPOHYDRATION [ORTOSTATICHESKAIA USTOICHIVOST' ZDOROVOGO CHELOVEKA PRI GIPOGIDRATATSII]**

V. B. NOSKOV, A. N. KOTOV, M. IU. VOLKOV, O. N. RUSTAM'IAN, IU. V. SUKHANOV et al. Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 112-117. In Russian. refs

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The effect of decreasing the volume of circulating blood or plasma (VCBP), induced by the administration of furosemide, on the orthostatic stability of healthy human subjects was investigated by measuring pulse rate (PR) and pulse pressure (PP) as indices of orthostatic stability. The cardiorespiratory-system parameters before and during the orthostatic test were measured, and the state of water-salt metabolism was estimated. It was found that reactions of the cardiorespiratory system to orthostasis were affected both by hypovolemia and by the activity of neural hormones (antidiuretic hormone, plasma renin), which were found to increase as a response to hypovolemia and which counteracted its negative effect on orthostatic stability. I.S.

A90-29080

**ACID-BASE STATE OF THE HUMAN ORGANISM DURING BREATHING IN AIR WITH VARIOUS CONCENTRATIONS OF CARBON DIOXIDE [KISLOTNO-OSNOVNOE SOSTOIANIE ORGANIZMA CHELOVEKA PRI DYKHANII VOZDUKHOM S PRIMES'IU RAZLICHNYKH KONTSENTRATSII DVUOKISI UGLERODA]**

I. A. SAPOV, V. I. KULESHOV, I. V. LEVSHIN, and IU. IU. KEERIG (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 127-132. In Russian. refs

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The effect of high concentrations of CO<sub>2</sub> (3.5, 4.5, or 5.5 percent) in air on blood acid-base balance was investigated by measuring indices of the acid-base state in arterial and venous blood of human subjects exposed for 22, 42, and 72 hours in the CO<sub>2</sub>-rich atmosphere. It was found that hypercapnia was at the highest level in subjects who were breathing 5.5 percent CO<sub>2</sub> and who also exhibited symptoms of blood hypoxia and metabolic acidosis. In subjects breathing air containing 3.5 or 4.5 percent CO<sub>2</sub> these symptoms were much less severe even after prolonged periods of exposure, indicating that the bicarbonate buffer was still functioning effectively at these conditions. I.S.

A90-29081

**ESTABLISHING FUNCTIONAL STATES OF THE RESPIRATORY AND THERMOREGULATORY SYSTEMS DURING WORK IN AN ATMOSPHERE CONTAINING A HIGH LEVEL OF CARBON DIOXIDE [FORMIROVANIE FUNKSIONAL'NOGO SOSTOIANIIA SISTEM DYKHANIIA I TERMOREGULIATSII PRI RABOTE V ATMOSFERE S POVYSHENNYM SODERZHANIEM DVIUKISI UGLERODA]**

S. V. LEVINSKII and I. I. MALKIMAN Fiziologiya Cheloveka (ISSN 0131-1646), vol. 16, Jan.-Feb. 1990, p. 133-140. In Russian. refs

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The effect of high concentrations of atmospheric CO<sub>2</sub> on the respiratory and thermoregulatory systems and the gas exchange process of humans was investigated in subjects spending 4 hrs/day for three consecutive days in an atmosphere containing 5-6 vol pct CO<sub>2</sub>. Subjects were asked to perform physical exercises until reaching the limit of tolerance. Results indicated that the key reactions detected by measuring the parameters of the respiratory, heat, and gas exchange were directed toward the removal of the excess CO<sub>2</sub> from the body by increasing the minute respiration volume and the CO<sub>2</sub> concentration in exhaled air. The ratio of these two indices determined the condition of the particular subject with respect to the threshold of permissible CO<sub>2</sub> content. It is suggested that these reactions can be used to select individuals with high tolerance to CO<sub>2</sub>-enriched air. I.S.

A90-29151

**A MODEL OF HUMAN METABOLIC MASSFLOW RATES FOR AN ENGINEERED CLOSED ECOSYSTEM**

M. J. CONDRAN, W. Z. SADEH, D. W. HENDRICKS (Colorado State University, Fort Collins), and M. E. BRZECZEK (Martin Marietta Corp., Astronautics Group, Denver, CO) Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs

(SAE PAPER 891486) Copyright

A computer simulation model of the human metabolic system describing the massflow rates of the input and output metabolic elements was developed. The input metabolic elements consist of oxygen, dry food, and water, while the output elements include carbon dioxide, feces, urine and insensible water. Energy expenditure rate was introduced as the fundamental quantity, and its dependence upon the body mass and energy activity category was modeled. Four energy activity categories, i.e., work, exercise, leisure, and sleep, were considered. All the metabolic massflow rates were expressed in terms of the energy expenditure rate by means of linear relations. Integration and demonstration of the model of the metabolic system was accomplished using a scenario of daily distribution of energy activity categories and dry food composition for a given body mass. The results indicate the sensitivity of the calculated input/output metabolic massflow rates to the body mass and the selected scenario. Author

A90-29499

**HIGH-ALTITUDE MEDICINE AND PATHOLOGY**

DONALD HEATH and DAVID REID WILLIAMS (Liverpool, University, England) London and Boston, MA, Butterworths, 1989, 363 p. refs

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The biological processes of adjustment to high altitude are discussed, including the clinical, physiological, and pathological features of diseases related to the deprivation of oxygen at high altitudes. Consideration is given to the effects of high altitude on pulmonary diffusion, oxygen transport and release, tissue diffusion, carotid bodies, hemoglobins, blood coagulations, pulmonary hypertension, circulation, renal function and electrolytes, body weight, endocrines, fertility and pregnancy, skin and nails, the senses, sleep, and cerebral function. Benign acute mountain sickness, high-altitude pulmonary edema, cerebral mountain sickness, and Monge's disease are examined. Also, attention is given to the physiological and pathological characteristics of native highlanders, astronomers at high altitude, and athletic performance

at moderate altitude. Other topics include exposure to extreme altitudes, descent to sea level, and adaptation to hypobaric hypoxia. R.B.

A90-30349

**CURRENT PROBLEMS IN THE MEDICAL SUPPORT OF FLIGHTS [AKTUAL'NYE PROBLEMY MEDITSINSKOGO OBESPECHENIIA POLETOV]**

S. A. BUGROV and N. I. FROLOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Dec. 1989, p. 51-54. In Russian.

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The three main directions in medical flight support are reviewed. The clinical-physiological direction is aimed at assuring the necessary health standard of personnel by medical check-ups utilizing modern diagnostics, and subsequent preventive, therapeutic, and remedial measures. The psychophysiological direction is aimed at increasing the physiological and mental reliability and effectiveness of a pilot, and is realized by a special psychophysiological training complex. The physiological-hygienic direction is a complex of hygienic requirements on the personnel's work and rest environment on the ground, as well as safety regulations. N.B.

A90-30581

**MORTALITY AND CANCER INCIDENCE IN A COHORT OF COMMERCIAL AIRLINE PILOTS**

PIERRE R. BAND, JOHN J. SPINELLI, VINCENT T. Y. NG, JOANNE MOODY, and RICHARD P. GALLAGHER (British Columbia, Cancer Control Agency, Vancouver, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 299-302. Research supported by the Health Care Research Foundation and Workers' Compensation Board of British Columbia. refs

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Results are presented on a study of mortality and cancer incidence in a cohort of male pilots (a total of 913) employed since January 1950 by CP Air, now Canadian Airlines International. The mortality and cancer incidence of the cohort were compared, using standardized mortality and incidence ratios, respectively, with that of the British Columbia population. Excess deaths were observed for aircraft accidents, brain cancer, and rectal cancer, while excess cancer incidence was noted for nonmelanoma skin cancer, brain cancer, and Hodgkin's disease. I.S.

A90-30582

**DYNAMIC CARDIOVASCULAR RESPONSE TO +GZ STRESS IN AEROBICALLY TRAINED INDIVIDUALS**

ESTRELLA M. FORSTER and JAMES E. WHINNERY (U.S. Navy, Naval Air Development Center, Warminster, PA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 303-306. refs

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The effect of aerobic training on the cardiovascular response to +Gz stress was investigated by measuring the heart rate response to gradual and rapid-onset +Gz stress in both unconditioned human subjects and in aerobically trained individuals (runners). Long-term aerobic conditioning induced enhanced parasympathetic tone, resulting in a reduced heart rate at rest and during +Gz stress. However, aerobic conditioning was not found to alter the responsiveness of the heart rate to +Gz stress, compared to the unconditioned subjects, when the following variables were measured: the heart rate change from rest to the maximum-exposure heart rate, the heart rate change from rest to the heart rate achieved at the onset of maximum G, and the rate of change in heart rate per unit +Gz. I.S.

A90-30583

**REFLEX VENOMOTOR RESPONSES TO LOWER BODY NEGATIVE PRESSURE FOLLOWING ENDURANCE TRAINING**

NEIL B. VROMAN, JOHN A. HEALY, and ROBERT KERTZER (New Hampshire, University, Durham) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p.

307-309. refs

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The effect of endurance training on the reflex control of capacitance vessels during lower body negative pressure (LBNP) was investigated in sedentary male subjects divided into two groups: a control group (C), which remained sedentary, and an exercise (E) group, which underwent 12 weeks of endurance exercise training. As compared with the control, the E group was found to have significantly increased values for maximal oxygen uptake. However, during the exposures to two levels of LBNP (-10 and -40 mm Hg), both C and E subjects exhibited similar graded decreases in forearm venous volume, indicating that the reflex vasoconstrictor response to LBNP was not affected by endurance training. I.S.

**A90-30584\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**ENERGY ABSORPTION, LEAN BODY MASS, AND TOTAL BODY FAT CHANGES DURING 5 WEEKS OF CONTINUOUS BED REST**

JEAN M. KREBS, HARLAN EVANS, MIKE C. KUO (NASA, Johnson Space Center; Krug International Corp., Houston, TX), VICTOR S. SCHNEIDER (Texas, University, Houston), and ADRIAN D. LEBLANC (Baylor College of Medicine, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 314-318. Research supported by NASA. refs (Contract NIH-RR-00350; NIH-RR-02558)

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The nature of the body composition changes due to inactivity was examined together with the question of whether these changes are secondary to changes in energy absorption. Volunteers were 15 healthy males who lived on a metabolic research ward under close staff supervision for 11 weeks. Subjects were ambulatory during the first six weeks and remained in continuous bed rest for the last five weeks of the study. Six male volunteers (age 24-61 years) were selected for body composition measurements. Nine different male volunteers (age 21-50 years) were selected for energy absorption measurements. The volunteers were fed weighed conventional foods on a constant 7-d rotation menu. The average daily caloric content was 2,592 kcal. Comparing the five weeks of continuous bed rest with the previous six weeks of ambulation, it was observed that there was no change in energy absorption or total body weight during bed rest, but a significant decrease in lean body mass and a significant increase in total body fat (p less than 0.05). Author

**A90-30586**

**BRAIN GLUCOSE UTILIZATION UNDER HIGH SENSORY**

**ACTIVATION - HYPOACTIVATION OF PREFRONTAL CORTEX**

A. M. GOFFINET, A. G. DE VOLDER, A. BOL, and CH. MICHEL (Louvain, Universite Catholique, Louvain-la-Neuve, Belgium) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 338-342. Research supported by the Fonds de la Recherche Scientifique et Medicale of Belgium. refs (Contract AF-AFOSR-86-0353)

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Brain glucose metabolism was studied, using positron emission tomography and (F-18)-2-deoxy-2-fluoro-D-glucose, in 13 healthy young adult men, at rest and under conditions of high visual and auditory stimulation with minor motor involvement. Despite high individual variations, the mean cerebral metabolic rate for glucose was highly increased during stimulation. Furthermore, the regional pattern of cerebral glucose utilization showed consistent differences between resting and activated states. Several brain areas, including temporal, motor-premotor and parieto-occipital cortices, and striatum, thalamus, and cerebellum showed a level of activation statistically comparable to that of mean gray. Significant preferential activation was found only in the visual cortex. By contrast, prefrontal and mesial cortical areas were relatively hypoactivated by the task. Inasmuch as prefrontal cortex is known to receive visual associative afferents, these observations are tentatively interpreted in terms of the 'parallel' mode of information processing, along specific routes according to the environmental state. Author

**A90-30588**

**RELATION BETWEEN FLIGHT HOURS AND PERIPHERAL NERVOUS CONDUCTION VELOCITY**

J. L. GARCIA ALCON, J. M. MORENO VAZQUEZ, P. MENA ARIAS, M. MARTINEZ MARTINEZ, and J. E. CAMPILLO ALVAREZ (Ejercito del Aire, Talavera AFB; Extremadura, Universidad; 'Infanta Cristina' Hospital, Badajoz, Spain) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 353-355. refs

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The peripheral nervous system is highly sensitive to variations in the internal medium. A neurophysiological study (peripheral nervous conduction velocity) and an enzymatic study (catalase and glutathione-peroxidase) were performed in both instructor and student pilots. Pilots do not show the age-dependent decrease in the peripheral sensory nervous conduction velocity observed in nonpilot subject controls. The sensory conduction velocity was significantly (p less than 0.01) increased when hours of flight experience increased, yielding a positive correlation. A significant (p less than 0.01) increase in the erythrocyte catalase and glutathione-peroxidase activities were observed in pilots vs controls. The present data suggest that a chronically increased oxygen consumption could be the reason for the increase in peripheral nervous conduction velocity observed in pilots. Author

**A90-30590**

**ACUPRESSURE AND MOTION SICKNESS**

D. G. BRUCE, J. F. GOLDING, N. HOCKENHULL, and R. J. PETHYBRIDGE (Institute of Naval Medicine, Alverstoke, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 361-365. refs

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The effectiveness of the 'Sea Band' acupressure band compared with placebo and hyoscine (0.6 mg), also known as scopolamine, to increase tolerance to a laboratory nauseogenic cross-coupled motion challenge was assessed using 18 subjects. The results showed that the subjects had a significant increase in tolerance with hyoscine but had no increase in tolerance with the 'Sea Band' or placebo. Possible reasons for the failure to show any significant protection from the use of these acupressure bands are insufficient movement of the wrist to provide continuous stimulation, and/or the likelihood that only a minority of the population would show non-negligible benefit as experience with medical acupressure would suggest. The application of transcutaneous electrical nerve stimulation may be worthy of study. Author

**A90-30591**

**HYDROSTATIC HOMEOSTATIC EFFECTS DURING CHANGING FORCE ENVIRONMENTS**

EARL H. WOOD Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 366-373. Research supported by DARPA. refs (Contract N66001-87-C-0079)

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The G tolerance of internal organs depends on how closely force environments in body cavities mimic an aqueous system. Hydrostatic gradients in peritoneal and pericardial cavities sustain venous return and uniform transmural pressures so that normotensive arterial pressures at heart level persist during initial (about 7 s) sudden sustained exposures to Gz acceleration followed by a compensatory baroreceptor-mediated hypertension. Further, cerebrospinal fluid hydrostatics-mediated negative intracranial pressures sustain cerebral perfusion and cognition in spite of Gz-produced zero or near zero systolic pressures at head level. Differences in the approximately 0 and 1.0 specific gravities of intra-alveolar gases and surrounding blood and tissues, respectively, render lung anatomy and functions highly susceptible to the force environment. Hydrostatic gradients in dependent regions, simultaneously with small gradients in superior regions, appear to be nature's method for decreasing force environment-mediated regional ventilation and perfusion inequalities within the thorax. Author

A90-30733

**OBJECTIVE DOCUMENTATION AND MONITORING OF HUMAN GZ TOLERANCE**

EARL H. WOOD (Mayo Medical Center, Rochester, MN) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 774-777. refs

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Close correlations between noninvasively recorded changes in blood content of the ear and simultaneous intraarterial pressures at head level support the more widespread use of noninvasive monitoring and recording of circulatory changes at head level for objective measurements of Gz tolerance (unprotected and using anti-G suits, alone and in conjunction with various self-protective respiratory and musculature-straining maneuvers). The use of circulatory changes at head level to warn of impending loss of vision and/or consciousness for training purposes and as an activating signal for an automatic plane control system in potential gound impact situations is validated. The development of an unobtrusive within-the-ear photoelectric or ultrasound transducer, remotely controlled and received by a self-contained helmet or cockpit system, would enhance pilot acceptability and the practicality of such a system. I.E.

A90-31362

**THE EFFECTS OF 48 HOURS TOTAL SLEEP DEPRIVATION ON HUMAN PHYSIOLOGY, MOOD, AND MEMORY**

MARY L. RANKIN, GEORGIA LATHAM, ROBERT D. PETERS, and DAVID M. PENETAR (U.S. Army, Walter Reed Army Institute of Research, Washington, DC) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 625-629. refs

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Previous research regarding the effects of sleep deprivation (SD) on human physiology and mood has yielded conflicting results. These findings may in part be due to the use of small sample sizes and the failure to separate out the pure effects of SD from those of circadian rhythms during data analysis. One purpose of this study was to clearly identify the effects of 48 hours of SD on blood pressure, temperature, heart rate, and mood by overcoming the limitations of previous research. A second purpose was to evaluate the effects of SD on recognition memory. A repeated measures design was employed to collect physiological, mood, and memory data over a 48 hour period. While strong circadian rhythms were observed for most of the physiological and mood variables, recognition memory was unaffected by 48 hours of SD.

Author

N90-18854 Kansas State Univ., Manhattan.

**THE ROLE OF BLOOD VOLUME IN DETERMINING THE CARDIOVASCULAR ADJUSTMENTS TO EXERCISE Ph.D. Thesis**

MARI KAROL HOPPER 1989 60 p

Avail: Univ. Microfilms Order No. DA8924324

The effect of altering blood volume on mean right atrial pressure (RAP) was determined at rest and during exercise in five horses. Blood volume was increased by intravenously infusing dextran (DI) and decreased by administering a diuretic, furosemide (FUR). DI significantly increased mean pulmonary artery pressure above control during all levels of exercise while FUR reduced it during severe exercise. Thus, increasing blood volume increases central venous filling pressure while decreasing blood volume has the opposite effect. The effects of altering mean right atrial pressure on the cardiovascular adjustments to exercise were determined in six horses. Increasing plasma volume by DI increased RAP at rest and during all levels of exercise while decreasing plasma volume by FUR administration decreased it. Subsequently, cardiac output was increased with DI and reduced with FUR entirely due to change in stroke volume as heart rate was virtually unchanged by either treatment. Mean systemic arterial blood pressure did not

change following DI; therefore, calculated total peripheral resistance was reduced. Dissert. Abstr.

N90-18855 Yeshiva Univ., New York, NY.  
**CORONARY ARTERIAL CAPACITANCE AND SUBENDOCARDIAL VASCULAR PATENCY THROUGHOUT THE CARDIAC CYCLE Ph.D. Thesis**

MENGJIA ZHAO 1988 185 p

Avail: Univ. Microfilms Order No. DA8919248

Coronary blood flow undergoes phasic and transmural changes throughout the cardiac cycle. The mechanisms of these changes have not been completely elucidated. The role of coronary arterial capacitance in temporal and transmural variation of coronary flow was studied. It was hypothesized that coronary arterial capacitance may change the phasic coronary inflow pattern temporally at microcirculatory level and redistributes myocardial blood flow transmurally. The pressure within this capacitive function may act as the distending pressure to maintain vascular patency throughout the cardiac cycle. These hypotheses were tested with two different experimental approaches. In the first series of experiments, the role of coronary arterial capacitance in temporal variation and transmural distribution of the regional blood flow was studied in 15 dogs. In another series of experiments, the exchange vessel patency during normal and subendocardial hypoperfusion was studied by comparing the transmural pattern of exchange vessel surface area with the simultaneous flow pattern in 21 dogs. The results of these two studies suggest that although the apparent coronary inflow ceases during systole, the flow at the exchange level persists throughout the cardiac cycle with the coronary arterial capacitance as the potential driving pressure. Dissert. Abstr.

N90-18856# Oak Ridge National Lab., TN. Health and Safety Research Div.

**RISK ANALYSIS: FUNDAMENTAL CONCEPTS, REGULATORY TOXICOLOGY, AND RELATIVE COMPARISONS FROM RADIATION BIOLOGY**

TROYCE D. JONES 1990 25 p Presented at the Health Physics Society Midyear Topical Symposium on Risk Analysis, Atlantic City, NJ, 5 Feb. 1990

(Contract DE-AC05-84OR-21400)

(DE90-002466; CONF-900246-1) Avail: NTIS HC A03/MF A01

This talk uses fundamental concepts, and through usage reviews some definitions (which are underlined in the text) in the area of generalized risk analysis, methods currently used in regulatory toxicology to evaluate risk or hazard from carcinogenic and noncarcinogenic chemicals, and basic radiation physics and radiobiology as related to x and gamma photons. After a review of fundamentals, a suggested modification is made to use concepts which have been applied for decades in radiation protection as a template to reduce inaccuracies and uncertainties in hazard evaluations for nonradiological pollutants. A two step process is proposed: first the relative potency of agent A with respect to the reference agent, B, is defined in terms of the treatments, T(sub A), and, T(sub B), which produce equal biological effect. Relative potency is then T(sub B)/T(sub A). This exercise yields a unitless hazard ranking. The second step is to couple the unitless hazard ranking to reference exposures which have been generally regarded as safe. Those reference exposures could be taken as the natural terrestrial radiation background, the toxicological equivalent of a reference meal comprised of common foodstuffs, or the toxicological equivalent of utility processes but otherwise pure drinking water. DOE

N90-18857# Maryland Univ., College Park. Dept. of Electrical Engineering.

**EFFECTS OF PULSED AND CW (CONTINUOUS WAVE) 2450 MHZ RADIATION ON TRANSFORMATION AND CHROMOSOMES OF HUMAN LYMPHOCYTES IN VITRO Final Report, 1 Oct. 1986 - 15 Dec. 1989**

CHRISTOPHER C. DAVIS 15 Dec. 1989 52 p

(Contract N00014-86-K-0716)

(AD-A216500) Avail: NTIS HC A04/MF A01 CSCL 06/4

The results of research are described for the following areas:

whether spontaneous or phytohemagglutinin-induced transformation of human lymphocytes in vitro is affected by exposure to continuous wave (CW) or pulsed wave (PW) 2450 MHz microwaves; comparison of CW and PW microwave exposure at the same average specific absorption rate (SAR) - PW is markedly different and acts in a non-heating way; comparison of effects obtained by microwave and conventional heating needed to elevate the sample temperature by 0.5, 1.0, 1.5 and 2.0 C; and to determine whether chromosomal aberrations are induced under the conditions of the experiment. GRA

**N90-18858#** Smith-Kettlewell Inst. of Visual Sciences, San Francisco, CA.

**VISUAL PROCESSING OF OBJECT VELOCITY AND ACCELERATION Annual Technical Report No. 1, 15 Oct. 1988 - 14 Oct. 1989**

SUZANNE P. MCKEE 14 Dec. 1989 4 p  
(Contract AF-AFOSR-0035-89; AF PROJ. 2313)  
(AD-A216509; AFOSR-89-1884TR) Avail: NTIS HC A01/MF A01 CSCL 06/4

Several models of human motion discrimination have been proposed over the last decade. All are loosely related to the correlator approach originally used by Hassenstein and Reichardt to describe motion discrimination in insect eyes. These correlator models use simple spatial and temporal filtering followed by a non-linear multiplicative operation to account for human direction discrimination of sinusoidal stimuli near contrast threshold. Nevertheless, these models are extremely limited in scope. Research in this laboratory has shown that the correlator models cannot explain human speed discrimination even for sinusoidal targets. Apparently, a higher order network formed by combining local motion energy units is required to encode speed. This laboratory has also studied how different features (object components) are combined so that complicated objects move at a uniform velocity. The combination rules are fairly arbitrary, but are limited by physical constraints. Basically, features with similar contrasts, wavelengths, spatial frequencies and temporal frequencies are combined to form a coherent whole moving at a single perceived velocity. Dissimilar features move independently. GRA

**N90-18859#** Brigham and Women's Hospital, Boston, MA.

**A PROGRAM FOR THE STUDY OF SKELETAL MUSCLE CATABOLISM FOLLOWING PHYSICAL TRAUMA Final Report, 21 Feb. 1986 - 20 Feb. 1989**

DOUGLAS W. WILMORE 25 Nov. 1989 16 p  
(Contract DAMD17-86-C-6157; DA PROJ. 351-62772-A-874)  
(AD-A216569) Avail: NTIS HC A03/MF A01 CSCL 06/4

Prostaglandins may play a central role in the protein catabolic response following injury. Following operative injury, blocking prostaglandin generation reduced nitrogen excretion and tended to diminish hind leg amino acid flux. PGE2 infusion increased skeletal muscle amino acid flux. Altering leg blood flow by sympathectomy and nerve stimulation failed to alter skeletal muscle protein breakdown. High dose narcotic anesthesia tended to inhibit catabolic responses, suggesting that the central nervous system is important in these responses. Prostaglandin inhibition should be evaluated as a method of reducing the response to injury in humans. GRA

**N90-18860#** Harvard Univ., Cambridge, MA. Div. of Applied Sciences.

**THE EFFECTS OF LUMINANCE BOUNDARIES ON COLOR PERCEPTION Final Report, 15 Sep. 1986 - 14 Mar. 1989**

RICHARD E. KRONAUER, R. T. ESKEW, JR., and CHARLES F. STROMEYER, III 15 Nov. 1989 47 p  
(Contract AF-AFOSR-0338-86; AF PROJ. 2313)  
(AD-A216741; AFOSR-89-1676TR) Avail: NTIS HC A03/MF A01 CSCL 06/4

When a suprathreshold luminance flash, presented as an increment on a larger background field, accompanies a circular isoluminant chromatic flash at the same spatial location, chromatic threshold is reduced by about two-fold. This facilitation results

from the clearly visible edges of the luminance flash (the pedestal) serving to demarcate the test region, segregating it from its surround. Recent signal detection experiments show that this facilitation does not occur as a result of the contour's reducing the spatio-temporal detection uncertainty of the observer; instead of merely directing the observer's attention, the pedestal must alter the properties of chromatic detectors (by changing the extent of spatial integration, for instance). A thin luminance ring can be used to create the facilitating contour. Displacing the ring relative to the test causes the facilitation to decline sharply, as if the visual system integrated uniformly within the demarcated region. However, the contour does not have to enclose the test region: small segments of the ring presented on the test circumference have about half the maximum facilitatory effect, while 180 deg of arcs produces the whole effect. These results can be used as a rigorous means of probing the way in which low level visual attributes (edges, color) interact at higher levels. GRA

**N90-18861#** Wisconsin Univ., Milwaukee. Dept. of Psychology.  
**PERCEPTION OF LONG-PERIOD COMPLEX SOUNDS Annual Progress Report, 1 Sep. 1988 - 31 Oct. 1989**

RICHARD M. WARREN 27 Nov. 1989 76 p  
(Contract AF-AFOSR-0320-88; AF PROJ. 2313)  
(AD-A216743; AFOSR-89-1677TR) Avail: NTIS HC A05/MF A01 CSCL 06/4

Working with recycled sequences of ten 40 ms items, the discrimination of minimal changes was studied for: sinusoids, vowels, and frozen noise segments. Listeners made ABX judgments for sequences differing only in the ordering of two contiguous items. In contrast with results previously obtained for ten-item sequences presented in transient one-shot bursts, recycled stimuli were readily discriminated by untrained listeners. The relative difficulty of discriminating tonal patterns (measured by response time) was an inverse function of the frequency separation between the permuted tones and the frequency separation between the tones immediately preceding and following the permuted pair. For the vowel sequences, listeners' trial by trial reports indicate that discrimination of order was mediated by verbal organization involving introduction of illusory consonants and distortion of the vowels. Discrimination of order within sequences of frozen noise was more difficult than found with tone or vowel sequence but all listeners performed at levels well above chance. Additional work with recycled frozen noise is proceeding satisfactorily which deals with the ability to remember and recognize segments up to 1 s in duration, and the relative salience of various spectral regions in this process. GRA

**N90-18862#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**RECOGNIZING THREE-DIMENSIONAL OBJECTS WITHOUT THE USE OF MODELS Memorandum Report**

THOMAS MARILL Sep. 1989 27 p  
(Contract N00014-85-K-0124)  
(AD-A216766; AI-M-1157) Avail: NTIS HC A03/MF A01 CSCL 06/4

We present an approach to the problem of recognizing three-dimensional objects from line-drawings. In this approach there are no models. The system needs only to be given a single picture of an object; it can then recognize the object in arbitrary orientations. GRA

**N90-18863#** California Univ., Irvine.

**ORGANIZATION OF A LARGE-SCALE CORTICAL NETWORK Final Technical Report**

GARY LYNCH 1989 20 p  
(Contract N00014-86-K-0333)  
(AD-A216829) Avail: NTIS HC A02/MF A01 CSCL 06/4

This research program has been directed at discovering neurobiological features (cell specializations, activity patterns in collection of neurons, circuit design features) essential to the encoding, organizing, and utilizing recognition memories by networks in mammalian cortex. Three levels of work have been involved: (1) physiological and anatomical analyses of specific,

well defined examples of telencephalic networks; (2) translation of the neurobiological results into computer simulations of the networks; and (3) testing of the physiological and behavioral predictions of the computer models. It is anticipated that the results of the research will provide the bases of formal hypotheses regarding the links between cortical properties and computational operations and provide guidelines for the design of novel devices capable of dealing with the difficult computational problems presented by real world environments. GRA

**N90-18864#** Connecticut Univ., Storrs. Dept. of Communication Sciences.

**AUDITORY PERCEPTION Annual Technical Report, 1 Nov. 1988 - 31 Sep. 1989**

MARION F. COHEN 27 Nov. 1989 11 p  
(Contract AF-AFOSR-0008-89; AF PROJ. 2313)  
(AD-A217012; AFOSR-89-1674TR) Avail: NTIS HC A03/MF A01  
CSCL 06/4

During the past year we have conducted several experiments designed to study those stimulus characteristics which contribute to the ability of the auditory system to separate simultaneous signals. We have studied the effects of synchronous amplitude modulation, specifically the influence of changes in relative level of two stimuli, and have found that by changing relative levels of the two stimuli involved, the ear can detect temporal synchrony over a range of at least four octaves. We have also studied the effects of simultaneous gating, synchronous FM, and harmonicity on the ability of the auditory system to detect a signal in the presence of other stimuli. We have found that each of these characteristics contribute to signal separation. GRA

**N90-18865#** California Univ., Berkeley. Lawrence Berkeley Lab. Research Medicine and Radiation Biophysics Div.

**PERFORMANCE OF A COINCIDENCE BASED BLOOD ACTIVITY MONITOR**

WILLIAM W. MOSES Dec. 1989 5 p Presented at the IEEE Nuclear Science Symposium, San Francisco, CA, 22-26 Jan. 1990

(Contract DE-AC03-76SF-00098; NIH-RR-05918)  
(DE90-006105; LBL-27901; CONF-900143-16) Avail: NTIS HC A01/MF A01

A new device was constructed that measures the positron emitting radio tracer concentration in arterial blood by extracting blood with a peristaltic pump, then measuring the activity concentration by detecting coincident pairs of 511 keV photons with a pair of heavy inorganic scintillators attached to photomultiplier tubes. The sensitivity of this device is experimentally determined to be 610 counts/second per micro Ci/ml, and has a paralyzing dead time of 1.2 microsec, so is capable of measuring blood activity concentration as high as 1 mCi/ml. Its performance is compared to two other blood monitoring methods: discrete blood samples counted with a well counter and device that uses a plastic scintillator to directly detect positrons. The positron detection efficiency of this device for (sup 18)F is greater than the plastic scintillation counter, and also eliminates the radioisotope dependent correction factors necessary to convert count rate to absolute concentration. Coincident photon detection also has the potential of reducing the background compared to direct positron detection, thereby increasing the minimum detectable isotope concentration. DOE

**N90-18866#** Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France). Div. de Chimie-Toxicologie.

**STUDY OF RIFAMPICIN FIXATION ON PLASMA PROTEINS BY DERIVATIVE SPECTROPHOTOMETRY**

N. MARTIN, P. LAFARGUE, P. LEVILLAIN, and G. HOUIN Jun. 1989 23 p In FRENCH; ENGLISH summary  
(CERMA-89-25; ETN-90-96256) Avail: NTIS HC A03/MF A01

A new method to study fixation of drug molecules on plasma proteins is developed. The implemented technique is that of the annulation point observed in derivative spectrophotometry. This method is simple, rapid and requires no preliminary separation of the free form from the binded form. The obtained binding

parameters of rifampicin on albumin are comparable to those measured by the reference method of dialysis, in equilibrium conditions. ESA

**N90-18867#** Brookhaven National Lab., Upton, NY. Dept. of Applied Science.

**BIOMEDICAL APPLICATIONS OF SYNCHROTRON X RAY MICROSCOPY**

K. W. JONES, R. S. BOCKMAN, B. M. GORDON, M. L. RIVERS, A. J. SAUBERMANN, G. SCHIDLOVSKY, and P. SPANNE (Linkoeeping Univ., Sweden) Oct. 1989 13 p Presented at the 2nd International Workshop of X Ray Fluorescence (XRF) and PIXE Applications in Life Sciences, Capri, Italy, 29-30 Jun. 1989 Sponsored in part by Swedish Society of Medicine (Contract DE-AC02-76CH-00016; NIH-P41-RR-01838; NCI-CA-38645; NCI-CA-29502; SMRC-MFR-7557) (DE90-004957; BNL-42934; CONF-8906283-1) Avail: NTIS HC A03/MF A01

X ray beams produced in synchrotron storage rings are useful for many biomedical experiments since a very high flux of x rays can be delivered to a sample. The beam can be restricted to a diameter of less than 10 micros using appropriate optical systems or collimators. It is then possible to employ these beams to make elemental maps of biological materials using synchrotron radiation induced x ray emission (SRIXE) to identify particular elements or to use differences in the linear attenuation coefficients for computed microtomography (CMT). Biomedical applications of these methods will be illustrated using work done at the Brookhaven X-26 X Ray Microscope. DOE

**N90-18868#** Brookhaven National Lab., Upton, NY. Dept. of Medicine.

**MEASUREMENT OF BODY FAT BY NEUTRON INELASTIC SCATTERING: COMMENTS ON INSTALLATION, OPERATION, AND ERROR ANALYSIS**

JOSEPH J. KEHAYIAS, STEVEN B. HEYMSFIELD, F. AVRAHAM DILMANIAN, JACK WANG, DAVID M. GUNTHER, and RICHARD N. PIERSON, JR. (Tufts Univ., Boston, MA.) 1989 8 p Presented at the 1989 International Symposium on in Vivo Body Composition Studies, Toronto, Ontario, 20-23 Jun. 1989

(Contract DE-AC02-76CH-00016)  
(DE90-006765; BNL-43806; CONF-8906269-5) Avail: NTIS HC A02/MF A01

The existing techniques for the in vivo measurement of body fat can be classified into three categories: subtraction of lean body mass from total weight, measurement of a physical property of the body, and neutron inelastic scattering. This paper discusses the technique of neutron inelastic scattering, the analysis of spectral data, and the results. DOE

**N90-19737#** Oregon Univ., Eugene. Dept. of Psychology.

**VISUAL PROCESSING IN TEXTURE SEGREGATION Annual Report, 1 Sep. 1988 - 30 Sep. 1989**

JACOB BECK 29 Nov. 1989 64 p  
(Contract AF-AFOSR-0323-88; AF PROJ. 2313)  
(AD-A216539; AFOSR-89-1780TR) Avail: NTIS HC A04/MF A01  
CSCL 12/9

Beck (1988) reported that the outputs of 2-D Gabor filters can account for much of the segregation of a periodic visual display (tripartite pattern) into regions. We have conducted a series of experiments showing that grouping processes, as well as the outputs of spatial-frequency/orientation channels, yield automatic spontaneous segregation. In our tripartite patterns, the arrangement of local properties is different in different regions so that if the display is suitably filtered by convolving the appropriate property at each point, or by performing some equivalent filtering process in the Fourier domain, the regions in the filtered display differ in different regions. We have shown that this type of computation is not able to account for the spontaneous segregation of a line in a display of disconnected shapes. A striking finding reported by Beck (1988) was that squares differing by a large lightness difference sometimes failed to give region segregation in a tripartite

pattern while the same pattern of squares differing by a smaller lightness differences yielded strong region segregation. GRA

**N90-19738** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Afdeling Audiologie.

**VESTIBULAR EXAMINATION OF MOTION SICK STUDENT PILOTS**

W. BLES Dec. 1988 19 p In DUTCH; ENGLISH summary (Contract A83/KLU/115) (IZF-1988-22; TD-89-0531; ETN-90-95091) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

Seventeen student pilots of the Royal Dutch Air Force who experience severe motion sickness problems were examined on their equilibrium function. The results were evaluated with a view to selection tests of motion sickness susceptibility. Although presently there is no appropriate control group of experienced pilots, comparison with normal individuals indicates that Coriolis tests with congruent and incongruent sensory information can be useful. ESA

**N90-19739#** National Aerospace Medical Centre, Soesterberg (Netherlands).

**ACTIVITIES IN AEROSPACE MEDICINE Annual Report, 1987 [JAARVERSLAG 1987]**

1987 41 p In DUTCH (ETN-90-95468) Avail: NTIS HC A03/MF A01

The medical examinations of the personnel are tabulated and discussed. Research and development activities were performed in fields of psychodiagnostic examination and selection, ophthalmology, general medical examination, flight physiology, and the mental stress of helicopter pilots. ESA

**N90-19740#** Minnesota Univ., Duluth. Dept. of Biochemistry.

**METABOLISM, SEIZURES, AND BLOOD FLOW IN BRAIN FOLLOWING ORGANOPHOSPHATE EXPOSURE: MECHANISMS OF ACTION AND POSSIBLE THERAPEUTIC AGENTS Annual Summary Report, 21 Oct. 1986 - 20 Oct. 1987**

LESTER R. DREWES and PADALA V. REDDY 25 Aug. 1989 42 p (Contract DAMD17-86-C-6036; DA PROJ. 3M1-61102-BS-10) (AD-A217098) Avail: NTIS HC A03/MF A01 CSCL 15/6

The acute neurotoxicity of the organophosphorus (OP) compounds soman and sarin was investigated using the isolated, perfused canine brain preparation. Intracarotid injection of soman (100 ug) or sarin (400 ug) produced immediate vasodilation and seizure within 4 to 6 min. Rapid, large increases in cerebral metabolic rates for glucose, oxygen, lactate, and carbon dioxide were observed during seizure. To investigate the cholinergic mechanisms of OP-induced seizure and vasodilation, oxotremorine (10 uM), a muscarinic agonist, and arecoline (1 uM and 20 uM), a muscarinic and nicotinic agonist, were used. Both agonists quickly induced vasodilation but not seizure. When soman was injected, additional vasodilation occurred in brains pretreated with arecoline but not with oxotremorine; however, soman-induced seizure and hypermetabolism occurred in brains pretreated with arecoline. Oxotremorine treatment caused a substantially greater increase in glucose than in oxygen metabolism. Based on our results with cholinergic agonists and antagonists, the development of seizure and the vasodilation induced by OP agents are separate and independent responses. Consequently, independent mechanism(s) must exist for OP-induced cerebral vasodilation. GRA

## BEHAVIORAL SCIENCES

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

**A90-28185**

**HUMAN FACTORS IN EMS HELICOPTER OPERATIONS**

JOHN K. LAUBER and PHYLLIS J. KAYTEN (National Transportation Safety Board, Washington, DC) IN: AHS, Annual Forum, 45th, Boston, MA, May 22-24, 1989, Proceedings. Alexandria, VA, American Helicopter Society, 1989, p. 437-440. Copyright

The characteristics of Emergency Medical Service (EMS) helicopter operations which may contribute to the high estimated accident rate of this service are addressed. The factors considered include EMS pilots flying in marginal weather conditions, poor judgment resulting from factors common in the EMS environment, and the on-call nature of the EMS environment which leads to chronic fatigue. Accidents illustrating these factors are described. C.D.

**A90-29842\*** Stanford Univ., CA.

**TASK-DEPENDENT COLOR DISCRIMINATION**

ALLEN B. POIRSON and BRIAN A. WANDELL (Stanford University, CA) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 7, April 1990, p. 776-782. refs (Contract NIH-2-RO1-EY-03164; NCC2-307; NCC2-332) Copyright

When color video displays are used in time-critical applications (e.g., head-up displays, video control panels), the observer must discriminate among briefly presented targets seen within a complex spatial scene. Color-discrimination threshold are compared by using two tasks. In one task the observer makes color matches between two halves of a continuously displayed bipartite field. In a second task the observer detects a color target in a set of briefly presented objects. The data from both tasks are well summarized by ellipsoidal isosensitivity contours. The fitted ellipsoids differ both in their size, which indicates an absolute sensitivity difference, and orientation, which indicates a relative sensitivity difference. Author

**A90-29843\*** Stanford Univ., CA.

**SURFACE CHARACTERIZATIONS OF COLOR THRESHOLD**

ALLEN B. POIRSON, BRIAN A. WANDELL, DENISE C. VARNER, and DAVID H. BRAINARD (Stanford University, CA) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 7, April 1990, p. 783-789. refs (Contract NIH-2-RO1-EY-03164; NCC2-307; NCC2-332) Copyright

The paper evaluates how well three different parametric shapes, ellipsoids, rectangles, and parallelograms, serve as models of three-dimensional detection contours. The constraints of the procedures for deriving the best-fitting shapes on inferences about the theoretical visual detection mechanisms are described. Results of two statistical tests show that only the parallelogram fits the data with more precision than the variance in repeated threshold measurements, and thus provides a slightly better fit than the other two shapes. Nevertheless it does not serve as a better guide than the ellipsoidal model for interpolating from the measurements to thresholds in novel color directions. N.B.

**A90-30282**

**ENGINEERING CREATIVITY IN COMPUTER-AIDED DESIGN (PSYCHOLOGICAL ASPECTS) [TEKHNIЧЕСКОЕ**

**TVORCHESTVO V SAPR /PSIKHOLIGICHESKIE ASPEKTY/]** IURII L. TROFIMOV Kiev, Izdatel'stvo Vishcha Shkola, 1989, 184 p. In Russian. refs Copyright

The book is concerned with the role of the human factor in the development and operation of computer-aided design systems. Attention is given to the methodological problems of the

psychological support of engineering creativity; a problem-oriented functional approach to systems analysis in computer-aided design; and psychological aspects of the solution of engineering design problems. The discussion also covers models of individual and group activity control and an approach to the psychological management of the creative process in computer-aided design.

V.L.

**A90-30289**

**SPATIAL ORIENTATION OF PILOTS (PSYCHOLOGICAL ASPECTS) [PROSTRANSTVENNAIA ORIENTIROVKA PILOTOV /PSIKHOGICHESKIE OSOBENNOSTI/]**

PAVEL A. KOVALENKO Moscow, Izdatel'stvo Transport, 1989, 232 p. In Russian. refs  
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This book discusses methods used for training pilots for spatial orientation under visual and instrumental flight rules, i.e., the techniques used for the correct and timely determination of the spatial position, with air horizons defined by different principles. Consideration is given to the manipulative ability of the pilot's visual system and to tests designed to examine this ability, with special consideration given to the 'Aviagorizont' test. Particular attention is given to the potential composition of operative and invariable descriptive-conceptual models of spatial orientation.

I.S.

**A90-30589**

**AN EMPIRICAL ASSESSMENT OF STRESS-COPING STYLES IN MILITARY PILOTS**

JAMES J. PICANO (U.S. Army, School of Medicine, Fort Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, April 1990, p. 356-360. refs  
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Although aircraft pilots are generally regarded as having superior stress-coping skills, there has been relatively little empirical research on how pilots cope with stress. New stress-coping models and measures for understanding and assessing these previously elusive processes greatly facilitate the empirical study of stress-coping styles. This study employed a new measure of stress-coping style, rationally developed from an integrative model of coping, to study stress-coping in U.S. Army pilots. Results indicated that the pilots preferred problem-focused stress-coping strategies oriented toward direct action to master stressful situations. Also, the pilots tended to deemphasize emotion-focused forms of coping with stress. Differences in stress-coping between pilots and samples of aircrewmembers and non-rated military personnel suggest that this coping style reflects differences in psychological functioning independent from the pilots' adaptation to the aviation and military environment.

Author

**A90-30736#**

**ATTENTION ANOMALIES AS MEASURED BY TIME ESTIMATION UNDER G STRESS**

D. W. REPPERGER, J. W. FRAZIER, S. POPPER (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), and C. GOODYEAR (Systems Research Laboratories, Inc., Dayton, OH) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 787-793. refs

To investigate attention anomalies under G stress, performance tests involving the estimation of time duration were conducted at sustained levels of 1, 3, and 5-Gz stress for a duration of 60 sec. Two types of time-estimation tasks were conducted, counting and noncounting. Analysis of the data indicates that the minimum-duration counting task was grossly underestimated. Data were first analyzed across all subjects, and only the shortest counting task was affected by the 5-Gz stress condition. Overall, however, for a given stress level, the counting task was a much more accurate method of estimating time than noncounting. The 5-Gz stress level was slightly below the threshold to affect performance; however, for the documented case of one subject

under great mental stress, the results were significantly affected by the combination of 5-Gz and psychological stress. I.E.

**A90-31327\*** Miami Univ., Coral Gables, FL.

**REFLECTIONS ON HUMAN ERROR - MATTERS OF LIFE AND DEATH**

EARL L. WIENER (Miami, University, Coral Gables, FL) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 1-7. refs  
(Contract NCC2-377)  
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The last two decades have witnessed a rapid growth in the introduction of automatic devices into aircraft cockpits, and elsewhere in human-machine systems. This was motivated in part by the assumption that when human functioning is replaced by machine functioning, human error is eliminated. Experience to date shows that this is far from true, and that automation does not replace humans, but changes their role in the system, as well as the types and severity of the errors they make. This altered role may lead to fewer, but more critical errors. Intervention strategies to prevent these errors, or ameliorate their consequences include basic human factors engineering of the interface, enhanced warning and alerting systems, and more intelligent interfaces that understand the strategic intent of the crew and can detect and trap inconsistent or erroneous input before it affects the system.

Author

**A90-31328\*** Illinois Univ., Urbana.

**SPATIAL COGNITION AND NAVIGATION**

ANTHONY J. ARETZ (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 8-12. refs  
(Contract NAG2-308)  
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An experiment that provides data for the development of a cognitive model of pilot flight navigation is described. The experiment characterizes navigational awareness as the mental alignment of two frames of reference: (1) the ego centered reference frame that is established by the forward view out of the cockpit and (2) the world centered reference frame that is established by the aircraft's location on a map. The data support a model involving at least two components: (1) the perceptual encoding of the navigational landmarks and (2) the mental rotation of the map's world reference frame into alignment with the ego centered reference frame. The quantitative relationships of these two factors are provided as possible inputs for a computational model of spatial cognition during flight navigation. R.E.P.

**A90-31336**

**MODELING AIR TRAFFIC CONTROLLER PERFORMANCE IN HIGHLY AUTOMATED ENVIRONMENTS**

ELIZABETH D. MURPHY, RAY A. REAUX, LISA J. STEWART, WILLIAM D. COLEMAN, and KELLY HARWOOD (CTA, Inc., Rockville, MD) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 47-51. refs  
(Contract DTRS-87-86-C-00107)  
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As increasing levels of automation are planned for the United States' air traffic control system, there is a need to assess planned system design changes for their potential effects on human performance. The model of controller performance developed by this work permits the comparison of prior and planned system transition states on several performance dimensions: perceptual, analytic, response, and resource management. Systematic predictions of performance provide a basis for identifying potential trouble spots in a planned system. The model can be employed to determine whether system design changes will improve controller performance without placing unreasonable demands on the controller's resources. It can be tailored to represent human

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performance variables and sources of resource demand in any complex automated system. Author

**A90-31342\*** Illinois Univ., Champaign.

### **VISUAL SCANNING WITH OR WITHOUT SPATIAL UNCERTAINTY AND TIME-SHARING PERFORMANCE**

YILI LIU and CHRISTOPHER D. WICKENS (Illinois, University, Champaign) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 76-80. refs (Contract NAG2-308)

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An experiment is reported that examines the pattern of task interference between visual scanning as a sequential and selective attention process and other concurrent spatial or verbal processing tasks. A distinction is proposed between visual scanning with or without spatial uncertainty regarding the possible differential effects of these two types of scanning on interference with other concurrent processes. The experiment required the subject to perform a simulated primary tracking task, which was time-shared with a secondary spatial or verbal decision task. The relevant information that was needed to perform the decision tasks were displayed with or without spatial uncertainty. The experiment employed a 2 x 2 x 2 design with types of scanning (with or without spatial uncertainty), expected scanning distance (low/high), and codes of concurrent processing (spatial/verbal) as the three experimental factors. The results provide strong evidence that visual scanning as a spatial exploratory activity produces greater task interference with concurrent spatial tasks than with concurrent verbal tasks. Furthermore, spatial uncertainty in visual scanning is identified to be the crucial factor in producing this differential effect. Author

**A90-31346\*** Illinois Univ., Savoy.

### **PREDICTIVE PERFORMANCE MODELS AND MULTIPLE TASK PERFORMANCE**

CHRISTOPHER D. WICKENS, INGE LARISH, and AARON CONTORER (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 96-100. refs (Contract NAG2-308)

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Five models that predict how performance of multiple tasks will interact in complex task scenarios are discussed. The models are shown in terms of the assumptions they make about human operator divided attention. The different assumptions about attention are then empirically validated in a multitask helicopter flight simulation. It is concluded from this simulation that the most important assumption relates to the coding of demand level of different component tasks. R.E.P.

**A90-31350**

### **THE EFFECTS OF VISUAL CUES TO REALISM AND PERCEIVED IMPACT POINT DURING FINAL APPROACH**

WOODROW BARFIELD, CRAIG ROSENBERG, and CONRAD KRAFT (Washington, University, Seattle) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 115-119. refs (Contract NSF DMC-88-57851)

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This research investigated the effect of providing three different simulations of ground terrain on the ability of subjects to accurately determine the aimpoint during a final approach. Several simulations were created to model a straight-in final approach (3 degree glideslope) to a standard FAA runway from several distances. The three levels of terrain realism ranged from a homogeneous surface to farmlands with hills. The subject's task was to estimate the aimpoint which represented an extrapolation of the flightpath to its point-of-contact with the ground as well as the altitude at nine different distances from threshold. The results indicated that increased levels of realism lead to better performance in judging

altitude and predicting aimpoint during a simulated final approach.

Author

**A90-31360**

### **A CROSS-CULTURAL SURVEY OF PERSONAL PREFERENCES IN DESIGN AND OPERATION OF A LUNAR BASE**

JAMES A. WISE (Grand Valley State University, Grand Rapids, MI) and KRISTINA MCCONVILLE IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 526-530. refs

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This paper reports the results of a student survey conducted at the International Space University during its inaugural summer of 1988. The survey concerned personal preferences in design and operations options for a hypothetical lunar base which was the focus project for the class. The results showed potential cultural differences in desires for dress codes, alcohol usage, calendar observances and other design and operations procedures. These differences suggest that in the planning of future space bases, significant attention should be directed toward the special needs of culturally diverse crews to ensure that optimal habitability, job performance, and crew relations goals are realized. Author

**A90-31363**

### **HUMAN OPERATORS IN AUTOMATED SYSTEMS - THE IMPACT OF ACTIVE PARTICIPATION AND COMMUNICATION**

JACQUELINE R. IDASZAK (Georgia Institute of Technology, Atlanta) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 778-782. refs

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Operator-system participation and operator-operator communication were manipulated to investigate the effects of increases in active participation on operator monitoring and problem-solving performance. 112 subjects worked as operators of a simulated process system. Operators worked in teams of two on both a monitoring task and, after the system failed, a diagnostic task. The results of this study suggest that active participation in the system improved both monitoring and diagnostic performance while reducing boredom during monitoring and stress while diagnosing a failure. Communication tended to facilitate performance of active participants but degrade performance of passive participants. Author

**A90-31364**

### **CREW STRUCTURE, AUTOMATION AND COMMUNICATION - INTERACTION OF SOCIAL AND TECHNOLOGICAL FACTORS ON COMPLEX SYSTEMS PERFORMANCE**

SUSAN G. STRAUS and RUSSELL S. COOPER (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 783-787. refs (Contract N00014-86-K-0332)

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The effects of automation and task group social structure on group communication and performance are analyzed in a simulated flight experiment. The interaction of technological and social factors is studied through micro communication analysis of crew interaction during the flight simulation mission. Based on the analysis of recorded transcripts, no overall difference is found in communication patterns as a function of crew composition. However, the results indicate that heterogeneous crews tend to exchange a higher ratio of task relevant to task irrelevant statements compared to homogeneous crews. This interaction corresponds to performance data that show enhanced performance for heterogeneous crews in the automated condition. It is suggested that group structure and interaction may contribute to the observed performance differences. V.T.

A90-31365

**AIRCREW PERFORMANCE AS A FUNCTION OF AUTOMATION AND CREW COMPOSITION - A SIMULATOR STUDY**

CHRISTOPHER D. WICKENS, ROGER MARSH, MIREILLE RABY, SUSAN STRAUS, RUSSELL S. COOPER (Illinois, University, Savoy) et al. IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 792-796. refs  
(Contract N00014-86-K-0332)

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In an experiment designed to examine the effect of crew composition and automation level on flight performance, 50 pilot-copilot crews flew a simulated instrument flight mission between three Michigan cities. Half of the crews were of homogeneous composition (both low or both high time), while half were heterogeneous consisting of one senior high-time member and one junior low-time member. Within each group, roughly half flew with automated flight control and the other half flew manually. The flight was disrupted by periodic instrument failures. Results indicated that automation improved flight performance and lowered workload. While there was no overall difference in performance between homogeneous and heterogeneous crews, the latter group appeared to benefit more from the advantages that automation had to offer. The results are discussed in terms of the effect of automation on cockpit authority gradients, the role of flight experience, and of crew communications. Author

A90-31367

**INFORMATION PROCESSING COMPONENTS AND KNOWLEDGE REPRESENTATIONS - AN INDIVIDUAL DIFFERENCES APPROACH TO MODELING PILOT JUDGMENT**

BARBARA J. BARNETT (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 878-882. Research supported by USAF. refs  
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High-time and low-time pilot judgment performance is studied using information processing components and knowledge representations in long term memory as individual difference measures to predict performance. Profiles of pilot abilities are used to predict pilot judgment in a series of decision scenarios, each of which places differing demands on the pilot's information processing ability and utilization of knowledge representations or action scripts. It is concluded that knowledge representation measures can predict high time pilot performance, while information processing measures can better predict low time pilot performance. V.T.

A90-31368

**STRESS AND COGNITIVE PERFORMANCE IN TRAINEE PILOTS**

ALAN F. STOKES and MIREILLE RABY (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 883-887. Research supported by USAF. refs  
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The effect of task related stress upon aviation relevant cognitive skills in trainee instrument pilots is studied using an automated test battery. The battery is administered under stress and control conditions, providing data on the effects of the stress manipulation on putative cognitive components of decision making independent of the criterion task - simulated flight. The results provide evidence of stress related decrements in working memory, flexibility of closure, and spatial processes, but not in the retrieval of declarative knowledge. The results are discussed in the light of the model's predictions and previous results. V.T.

A90-31369

**PERSONALITY AND FLIGHT TRAINING PERFORMANCE**

RONALD N. SHULL and DANIEL L. DOLGIN (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) IN:

Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 891-895. refs

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Current naval aircrew selection research typically focuses on psychomotor and cognitive abilities, but evidence from flight training attrition studies suggests that many failures may be due to personality/motivational factors. This study concerns the relationships found between elements of primary flight training performance and the results of two automated personality assessment instruments: a risk test and a pilot personality questionnaire. Both risk test measures correlated significantly with a simple pass/fail index but not with actual flight grades for either student pilots or flight officers. Several of the pilot personality scales correlated significantly with various flight training criteria, but many of these were also not orthogonal to measures of the current Navy/Marine Corps aviation selection test battery, while both risk test measures were. Author

A90-31370

**PERFORMANCE-BASED TESTS, PERSONALITY ATTRIBUTES, AND TRAINING OUTCOME AMONG LANDING CRAFT AIR CUSHION (LCAC) VEHICLE OPERATORS**

T. NONTASAK, D. L. DOLGIN, and G. R. GRIFFIN (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 901-904. Research supported by the U.S. Navy.

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Development of a cognitive psychomotor multitask and personality oriented test battery for predicting the training outcome of LCAC operators is discussed. Dichotic listening, psychomotor, manikin, one-dimensional compensatory tracking, digit cancellation, and risk taking are used in automated tests. Training grade also correlated with the stick-rudder-throttle conditions of the psychomotor task and with the one-dimensional compensatory tracking task when performed in combination with the digit cancellation task. The results suggest that proficiency in multitask performance may be important in the acquisition of skills needed to learn the LCAC operator tasks. V.T.

A90-31373\* Colgate Univ., Hamilton, NY.

**TRAINING FOR SPACECRAFT TECHNICAL ANALYSTS**

THOMAS J. AYRES (Colgate University, Hamilton, NY) and LARRY BRYANT (JPL, Pasadena, CA) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1263-1267. refs

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Deep space missions such as Voyager rely upon a large team of expert analysts who monitor activity in the various engineering subsystems of the spacecraft and plan operations. Senior teammembers generally come from the spacecraft designers, and new analysts receive on-the-job training. Neither of these methods will suffice for the creation of a new team in the middle of a mission, which may be the situation during the Magellan mission. New approaches are recommended, including electronic documentation, explicit cognitive modeling, and coached practice with archived data. Author

A90-31374

**TRAINING POTENTIAL OF MULTIPLAYER AIR COMBAT SIMULATION**

MICHAEL R. HOUCK, GARY S. THOMAS (Dayton, University, Williams AFB, AZ), and HERBERT H. BELL (USAF, Human Resources Laboratory, Williams AFB, AZ) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1300-1304.

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The feasibility of supplementing current air combat mission training with ground-based multiship simulation is assessed. A

diverse group of F-15 pilots and tactical air controllers practiced two-ship air combat tactics in an unrestricted combat environment that included multiple air and surface threats, electronic combat, and real-time kill removal. These pilots and controllers evaluate the ability of the simulation to support the training of specific air combat tasks and compare the value of the training to current unit training. Interviews and questionnaires identifying strength and limitations of the simulation are analyzed; this information provides 'lessons learned' and functional requirements for future air combat training and research simulation. V.T.

**A90-31375\*** University of Southern California, Los Angeles.  
**THE EFFECTS OF PRACTICE ON TRACKING AND SUBJECTIVE WORKLOAD**

P. A. HANCOCK, M. A. ROBINSON, A. L. CHU, D. R. HANSEN, M. VERCRUYSSSEN (Southern California, University, Los Angeles, CA) et al. IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1310-1314. refs (Contract NCC2-379)  
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Six college-age male subjects performed one hundred, two-minute trials on a second-order tracking task. After each trial, subjects estimated perceived workload using both the NASA TLX and SWAT workload assessment procedures. Results confirmed an expected performance improvement on the tracking task which followed traditional learning curves within the performance of each individual. Perceived workload also decreased for both scales across trials. While performance variability significantly decreased across trials, workload variability remained constant. One month later, the same subjects returned to complete the second experiment in the sequence which was a retention replication of the first experiment. Results replicated those for the first experiment except that both performance error and workload were at reduced overall levels. Results in general affirm a parallel workload reduction with performance improvement, an observation consistent with a resource-based view of automaticity. Author

**A90-31379**  
**ATTENTION ALLOCATION IN SITUATION AWARENESS**

MARTIN L. FRACKER (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1396-1400. refs  
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Subjects were given a 'god's eye' view of an air battle involving aircraft: two were friendly, either one or three were hostile, and the rest were neutral. In one condition (Consistent FFN), which aircraft were friend, foe, or neutral was consistent throughout a trial. In another condition (Variable FFN), the identity of each aircraft changed randomly within a trial. In general, subjects' spatial awareness was best for enemy aircraft and worst for neutral aircraft. Increasing the number of enemy aircraft from one to three degraded spatial awareness for enemy aircraft in both FFN conditions. FFN awareness was also affected. These results are interpreted in terms of a limited capacity model of attention and subjects' attentional priorities. Author

**A90-31381**  
**THE USE OF JUDGMENT MATRICES IN SUBJECTIVE WORKLOAD ASSESSMENT - THE SUBJECTIVE WORKLOAD DOMINANCE (SWORD) TECHNIQUE**

MICHAEL A. VIDULICH (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1406-1410. refs  
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One objective of the project was to determine compare two analytic algorithms for converting judgment matrices into subjective workload ratings. The original eigenvector algorithm used in Saaty's Analytic Hierarchy Process (AHP) was compared an algorithm of

calculating geometric means. Also, three methods of identifying excessively inconsistent matrices were compared. Data from nine previous experiments were re-examined in the present analysis. There were no differences between the AHP ratings and the geometric mean ratings in terms of their sensitivity to the experimental manipulations. However, two of the inconsistency measures were successfully used to cull the data-sets of inconsistent matrices and improved the statistical sensitivity of one set of ratings. These findings suggest that: (1) the computationally simple geometric means algorithm can be used as an alternative to the eigenvector algorithm, and (2) culling inconsistent matrices can sometimes improve rating sensitivity. These findings, along with previous research, demonstrate that judgment matrices can be a very valuable workload assessment tool. The essential steps for the proper use of judgment matrices in workload assessment are reviewed. A user's guide and software are also being prepared to aid researchers and practitioners. Author

**A90-31384\*** Haifa Univ. (Israel).  
**ATTENTION IN DICHOPTIC AND BINOCULAR VISION**

RUTH KIMCHI (Haifa, University, Israel), YIFAT RUBIN, DANIEL GOPHER, and DAVID RAIJ (Technion - Israel Institute of Technology, Haifa) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1435-1439. Research supported by NASA. refs  
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The ability of human subjected to mobilize attention and cope with task requirements under dichoptic and binocular viewing was investigated in an experiment employing a target search task. Subjects were required to search for a target at either the global level, the local level, or at both levels of a compound stimulus. The tasks were performed in a focused attention condition in which subjects had to attend to the stimulus presented to one eye/field (under dichoptic and binocular viewings, respectively) and to ignore the stimulus presented to the irrelevant eye/field, and in a divided attention condition in which subjects had to attend to the stimuli presented to both eyes/fields. Subjects' performance was affected mainly by attention conditions which interacted with task requirements, rather than by viewing situation. An interesting effect of viewing was found for the local-directed search task in which the cost of dividing attention was higher under binocular than under dichoptic viewing. Author

**A90-31385\*** Monterey Technologies, Inc., Carmel, CA.  
**VISUALLY GUIDED CONTROL OF SELF MOTION**

LAWRENCE J. HETTINGER (Monterey Technologies, Inc., Carmel, CA), G. JOHN ANDERSEN, JOHN M. FLACH, GARY E. RICCIO (Illinois, University, Urbana), C. THOMAS BENNETT, and WALTER W. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1468, 1469.  
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A workshop entitled 'Visually Guided Control of Movement' was held at NASA Ames Research Center on June 26 - July 14, 1989. The workshop brought together individuals with diverse backgrounds related to the areas of the visual perception and control of motion. During the workshop, participants designed and conducted experiments using NASA Ames flight simulation research facilities. These studies contrasted participants' alternative theoretical approaches to the visual control of self motion. Panel members, drawn from the workshop's participants, will discuss their approaches to the study of the control of self motion and will present interpretations of the outcomes of the workshop. Author

**A90-31386**  
**OPERATOR WORKLOAD IN THE UH-60A BLACK HAWK - CREW RESULTS VS. TAWL MODEL PREDICTIONS**

HELENE P. IAVECCHIA (Analytics, Inc., Willow Grove, PA), PAUL M. LINTON (Sikorsky Aircraft, Stratford, CT), ALVAH C. BITTNER,

JR. (Battelle Human Affairs Research Center, Seattle, WA), and JAMES C. BYERS (EG&G Idaho National Engineering Laboratory, Idaho Falls) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1481-1485. refs (Contract MDA903-86-C-0384)

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An empirical study was undertaken to collect real-time workload estimates of pilots and copilots performing a resupply mission in a UH-60A flight simulator. Overall and peak workload (OW and PW) ratings were collected for 12 mission segments. These ratings were compared with OW and PW values predicted by the task-analysis/workload (TAWL) simulation model. High correlations were found between TAWL-based predictions and crew results for OW ( $r = 0.82 - 0.95$ ;  $p$  less than 0.01). Lower correlations were found for PW ( $r = 0.62$ ;  $p$  less than 0.05). Author

**A90-31387**

**OBJECTIVE AND SUBJECTIVE ASSESSMENT OF IMAGE RECOGNITION**

A. J. MCCLUMPHA and S. J. SELCON (RAF, Institute of Aviation Medicine, Farnborough, England) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1505-1509. refs

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The effect of target degradation on observers' recognition ability is analyzed using objective and subjective assessments. In particular, infrared line scan imagery is used to study the effect of line-to-line variation or pixel jitter on observers' recognition performance. The results show that the imposition of only one pixel jitter critically interferes with the recognition of small (seven line) infrared targets. It is emphasized that the effect of pixel jitter is found not to be specific to a particular type of imagery and is likely to generalize to other types of target and other imaging systems. The results from the subjective scaling are found to correlate closely to the error data; therefore this rating scale may have widespread utility in target acquisition studies. V.T.

**N90-18869#** Illinois Univ., Urbana. Dept. of Computer Science. **SYSTEMATICITY AS A SELECTION CONSTRAINT IN ANALOGICAL MAPPING**

CATHERINE A. CLEMENT (University of Eastern Kentucky, Richmond.) and DEDRE GENTNER 15 Sep. 1989 74 p (Contract N00014-89-J-1272; N00014-85-K-0559; HD07205-08) (AD-A216029; UIUCDCS-R-89-1558; UIIU-ENG-89-1777) Avail: NTIS HC A04/MF A01 CSDL 05/8

Analogy is often viewed as a partial similarity match between domains. But since between any two domains there are more partial similarities than good analogies, it follows that analogy is selective. Three experiments examined the selection constraint on which relations are mapped between a base and target in an analogy. In Experiment 1 subjects judged two matches to be included in an analogy: an isolated match, and a match embedded in a larger mapping system. Subjects preferred the embedded match. In Experiments 2 and 3 subjects made analogical predictions about a target domain. Subjects predicted information that followed from a causal system that matched the base domain, rather than the information that was equally plausible, but that created an isolated match with the base. Results support Gentner's (1983, 1989) structure-mapping theory that analogical mapping concerns systems and not individual predicates, and that attention to shared systematic structure constrains the selection of information to include in an analogy. GRA

**N90-18870#** Illinois Univ., Champaign. Model Based Measurement Lab.

**APPROPRIATENESS MEASUREMENT FOR COMPUTERIZED ADAPTIVE TESTS Final Technical Paper, Oct. 1987 - Jun. 1989**

GREGORY L. CANDELL and MICHAEL V. LEVINE Dec. 1989 63 p Submitted for publication

(Contract F41689-87-D-0012)

(AD-A216121; AFHRL-TP-89-15) Avail: NTIS HC A04/MF A01 CSDL 05/8

The effects of an initial sequence of random responses to 15-, 20-, and 25-item adaptive tests were examined in a series of simulation studies. Random responding on as two items had a substantial effect on an examinee's score. Thus it is important to determine whether (as a result of carelessness, test anxiety, computer anxiety, failure to understand instructions, or other reasons) an examinee has answered the first several items haphazardly. It was shown by use of an optimal appropriateness index, the likelihood ratio (LR) index, that a large proportion of faulty test scores can be identified. The performance of LR was evaluated by determining hit rates and false positive rates in a series of studies concerning: (1) comparisons with other indices, (2) the use of a security procedure during item selection for the adaptive test, (3) standardization, and (4) misspecification of the number of items with random answers. The LR index detected initial sequences of random responses with high accuracy with and without a security procedure during item selection. Other appropriateness indices were considerably less accurate. Standardization greatly decreased the power of LR at low false positive rates. Finally, misspecification of the length of the initial segment of random responses systematically reduced the power of the LR index to detect aberrance. GRA

**N90-18871#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**A SELF-ORGANIZING MULTIPLE-VIEW REPRESENTATION OF THREE-DIMENSIONAL OBJECTS**

SHIMON EDELMAN and DAPHNA WEINSHALL Aug. 1989 15 p

(Contract DACA76-85-C-0010; N00014-85-K-0124)

(AD-A216711; AI-M-1146) Avail: NTIS HC A03/MF A01 CSDL 05/8

We explore representation of 3D objects in which several distinct 2D views are stored for each object. We demonstrate the ability of a two-layer network of threshold summation units to support such representations. Using unsupervised Hebbian relaxation, we trained the network to recognize ten objects from different viewpoints. The training process led to the emergence of compact representations of the specific input views. When tested on novel views of the same objects, the network exhibited a substantial generalization capability. In simulated psychophysical experiments, the network's behavior was qualitatively similar to that of human subjects. GRA

**N90-18872#** Smith-Kettlewell Inst. of Visual Sciences, San Francisco, CA.

**PSYCHOLOGICAL STUDIES OF VISUAL CORTICAL**

**FUNCTION Annual Technical Report, No. 1, 1 Sep. 1988 - 31 Aug. 1989**

KEN NAKAYAMA 13 Nov. 1989 4 p

(Contract AF-AFOSR-0326-88; AF PROJ. 2313)

(AD-A217029; AFOSR-89-1678TR) Avail: NTIS HC A01/MF A01 CSDL 06/4

We have investigated a number of paradigms where odd targets have to be either detected or discriminated and where set size, prior knowledge of target identity, and other factors were varied. We have set up an eye movement monitoring experiment to use the speed and accuracy of saccades to supplement the psychophysical observations described above. We have been examining the phenomenon of color (or brightness) spreading, developing a paradigm to show that the filling of color could be interrupted by using an after-coming patterned mask. We are also making neutral models to account for the psychophysical observations as they emerge. GRA

**N90-19741\*#** BBN Systems and Technologies Corp., Cambridge, MA.

**FLIGHT CREW AIDING FOR RECOVERY FROM SUBSYSTEM FAILURES Final Report**

E. HUDLICKA, K. CORKER, R. SCHUDY, and SHELDON BARON

Jan. 1990 97 p  
 (Contract NAS1-17335)  
 (NASA-CR-181905; NAS 1.26:181905; REPT-6990) Avail: NTIS  
 HC A05/MF A01 CSCL 05/9

Some of the conceptual issues associated with pilot aiding systems are discussed and an implementation of one component of such an aiding system is described. It is essential that the format and content of the information the aiding system presents to the crew be compatible with the crew's mental models of the task. It is proposed that in order to cooperate effectively, both the aiding system and the flight crew should have consistent information processing models, especially at the point of interface. A general information processing strategy, developed by Rasmussen, was selected to serve as the bridge between the human and aiding system's information processes. The development and implementation of a model-based situation assessment and response generation system for commercial transport aircraft are described. The current implementation is a prototype which concentrates on engine and control surface failure situations and consequent flight emergencies. The aiding system, termed Recovery Recommendation System (RECORDS), uses a causal model of the relevant subset of the flight domain to simulate the effects of these failures and to generate appropriate responses, given the current aircraft state and the constraints of the current flight phase. Since detailed information about the aircraft state may not always be available, the model represents the domain at varying levels of abstraction and uses the less detailed abstraction levels to make inferences when exact information is not available. The structure of this model is described in detail. Author

**N90-19742#** Air War Coll., Maxwell AFB, AL.

#### **PILOT CANDIDATE SELECTION**

ROBERT M. NEGLEY, JR. and GERALD V. BOESCHE May  
 1989 121 p  
 (AD-A217296) Avail: NTIS HC A06/MF A01 CSCL 05/9

With the demand for pilots, there is a need to produce a better finished product from Undergraduate Pilot Training. The answer would seem to be Specialized Undergraduate Pilot Training, which is what the U.S. Air Force and Air Training Command are advocating and have been for years. Much research and development has been done, especially in the last 10 years, to come up with a better selection system for pilot candidates. An improved selection system would help decrease attrition and could be used for earlier track selection for Specialized Undergraduate Pilot Training. This paper evaluates the current selection system and the selection methods and tools that are available and could be used in the future. The main focus is on what selection criteria is the best predictor of success and should be used in the future to select candidates for pilot training. GRA

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### **MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

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

**A90-27702**

#### **A 99-PERCENT PURITY MOLECULAR SIEVE OXYGEN CONCENTRATOR**

GEORGE W. MILLER and CLARENCE F. THEIS (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAFE Journal, vol. 20, Spring 1990, p. 6-14. refs  
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The development of a new concentrator capable of producing 99-percent purity oxygen from compressed air is described. The applications is the production of breathable oxygen on military aircraft. The new concept of a molecular sieve oxygen concentrator (MSOC) combines the standard molecular sieve oxygen

concentrator technology with the secondary oxygen purifier techniques. The new MSOC consists of four interconnected adsorbent beds, and is constructed and operated by using the pressure swing adsorption technique. The apparatus is fed compressed air. By repeated steps of absorption and desorption, nitrogen and argon are separated from the compressed air, and a continuous stream of very high purity oxygen is produced. At an inlet air pressure of 40 psia, cycle time of 15 seconds, and bed temperature of 297K, the concentrator produces a product gas with an oxygen content of 99.6 percent. N.B.

**A90-27703**

#### **INTEGRATING OBOGS AND OBIGGS - THE V-22 CONCENTRATOR**

CHRISTOPHER T. TURNER (Litton Industries, Instruments and Life Support Div., Davenport, IA) SAFE Journal, vol. 20, Spring 1990, p. 16-22.

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The V-22 tilt-rotor VTOL aircraft's four-man crew will obtain its oxygen breathing supply from a compact, 60.5-lb unit integrating the functions of an on-board oxygen-generating system (OBOGS) with those of an on-board inert gas-generating system (OBIGGS). The integrated pressure-swing absorption technology unit, which is based on zeolite molecular sieves, diverts the oxygen-depleted gas evolved by OBOGS operation for OBIGGS fuel tank inerting, and achieves substantial weight-savings through the use of air-distribution components, structural members, and failure-monitoring functions that are shared by both system components. System reliability is enhanced through the use of a common rotary valve for distribution of air to both the oxygen and nitrogen beds. The need to minimize engine bleed air consumption prompted tradeoff studies concerned with the allocation of weight to oxygen vs nitrogen production. O.C.

**A90-27704**

#### **SKELETAL SEGMENT DEVELOPMENT FOR AN ADVANCED MANIKIN**

CAROLINE VANINGEN-DUNN, JOSEPH W. COLTMAN (Simula, Inc., Phoenix, AZ), and INTS KALEPS (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) SAFE Journal, vol. 20, Spring 1990, p. 35-41. refs

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To evaluate high-performance ejection seats under extreme conditions, the U.S. Air Force needs manikins able to provide human-like dynamic response during ejection seat testing. While the advanced dynamic anthropomorphic manikin (ADAM) has the ability to continuously monitor all its joint motions, the high density and stiffness of metal components limit design flexibility. To improve the accuracy of segment inertial properties, the use of advanced materials was investigated. In the initial phase of the program, a prototype thigh bone (femur) segment, compatible with the Hybrid III dummy, was developed, and subsequently subjected to a range of load tests. The program has established that the use of composite components is technically feasible, and that it reduces weight and improves segment compliance properties. N.B.

**A90-27705**

#### **THE EVOLUTION OF ON-BOARD INERT GAS GENERATION SYSTEMS (OBIGGS)**

ROBERT G. CLODFELTER (USAF, Wright Research and Development Center, Wright-Patterson AFB, OH) SAFE Journal, vol. 20, Spring 1990, p. 45-50. refs

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Fuel tank inerting is utilized as a protective measure against fire and explosion of an aircraft. The early attempts at inerting, such as fuel enrichment schemes, fuel fogging, use of exhaust gases from reciprocating engines, and the LN2 inerting system, have been found to be impractical or inadequate. A nitrogen inerting system promised to be most advantageous, and the efforts were focused on a system able to generate the inert gas on demand in flight, without adding to the aircraft weight and cost. Several OBIGGS were investigated. The final concept utilizes the pressure swing adsorption process, using Dow Chemical membrane modules

and Clifton Precision molecular sieve techniques. The first large-scale application of the OBIGGS technology will be the C-17 cargo aircraft, and it is also being considered for the B-52 and the F-16. N.B.

**A90-27721****HELPING COMBAT PILOTS SURVIVE**

BRIAN WANSTALL *Interavia* (ISSN 0020-5036), vol. 45, March 1990, p. 231-234.

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Technological advances in the U.S. and Europe to protect combat aircrews in high-performance military aircraft are discussed. The overall task is to match the human physiological envelope to the operational envelope in which humans must work. A non-military example cited is the suit designed with NASA to give astronauts protection up to 100,000 ft for launch and return. The various systems presented include: assisted positive-posture breathing in conjunction with the anti-G suit, to provide improved protection against high-G accelerations; a further refinement of the anti-G suit to incorporate enlargement of the current five bladders to wrap around and cover the whole of the legs; and an electrically controlled rate sensitive anti-G valve which is highly responsive to the magnitude of aircraft acceleration, and the rate of onset. Attention is also given to the development of the Crew Escape System Technologies ejection seat system to provide a seat that will adjust its trajectory to the circumstances to improve aircrew survival chances in ejections at high speed, low altitude, or inverted attitude. R.E.P.

**A90-28186\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**OVERVIEW OF NASA ROTORCRAFT HUMAN FACTORS RESEARCH**

SANDRA G. HART (NASA, Ames Research Center, Moffett Field, CA) IN: AHS, Annual Forum, 45th, Boston, MA, May 22-24, 1989, Proceedings. Alexandria, VA, American Helicopter Society, 1989, p. 441-453. refs

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The principal areas of research supported by the NASA Rotorcraft Human Factors Research Branch are reviewed. The program elements addressed include situational awareness, pilot/vehicle interface, mission management, and training. Representative examples of research conducted in these areas since 1987 are summarized. C.D.

**A90-28572****THE EUROPEAN EVA SUIT ENCLOSURE - CHALLENGES IN THE DEVELOPMENT AND DESIGN OF A NEW SPACESUIT**

Y. OLLIVIER, D. HORNET (AMDBA, S.A., Vaucresson, France), O. DROMARD (Aerazur, Issy-les-Moulineaux, France), and G. ALBERTINI (ESTEC, Noordwijk, Netherlands) Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. Research supported by ESA.

(SAE PAPER 891545) Copyright

The paper describes the results of the efforts carried out in Europe for the definition, design and development of an EVA Suit Enclosure Module (ESEM) operating at 500 hPa, within the frame of the development studies for the Hermes Spaceplane EVA System. The assessment of the main performance requirements of the ESEM has been supported by the results of previous EVA System Studies and by experimental activities. These activities included: tests with an ergonomic test bench for the definition of the entry concept and the main geometrical parameters of the Hard Upper Torso (HUT), soft materials thermal and mechanical characteristics evaluation, preliminary components tests. Following the results of the experimentation and knowing the lessons learned from the U.S. and USSR EVA experience, a preliminary design concept for the future ESEM was established. The main features of such concept are: hybrid suit (HUT and soft limbs) with rear entry, a lower torso with hip and thigh bearings, rolling convolute joints for the shoulder articulations. Author

**A90-28950#****THE ESA ASTRONAUT SLEEP RESTRAINT - ITS DEVELOPMENT AND USE ONBOARD SPACELAB AND MIR**

W. OCKELS and H. STOEWER (ESTEC, Noordwijk, Netherlands) *ESA Bulletin* (ISSN 0376-4265), no. 61, Feb. 1990, p. 71-76. In French.

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The necessity to provide an astronaut with comfortable sleeping conditions prompted the development of a new astronaut sleep restraint which could produce some kind of spring-like pressure and feedback over body and limbs. In its final concept the device, as designed by two Dutch scientists for ESA, presents a sleeping bag which provides a feedback pressure roughly proportional to the degree of stretching, and varies with sleeping positions. It consists of two sheets of Nomex cloth stretched by a tubular tensioning device: a system of peripheral pressure tubes and valves. The astronaut sleep restraint has been tested in orbit in two space missions: spacelab-D1 and MIR, and found acceptable for future space missions, especially the longer ones. N.B.

**A90-30116\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**SIMULATION TECHNOLOGY - A KEY TO EFFECTIVE MAN-MACHINE INTEGRATION FOR FUTURE COMBAT ROTORCRAFT SYSTEMS**

ANDREW W. KERR (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) *Vertiflite* (ISSN 0042-4455), vol. 36, Mar.-Apr. 1990, p. 24-29.

Copyright

The utilization of advanced simulation technology in the development of the non-real-time MANPRINT design tools in the Army/NASA Aircrew-Aircraft Integration (A3I) program is described. A description is then given of the Crew Station Research and Development Facilities, the primary tool for the application of MANPRINT principles. The purpose of the A3I program is to develop a rational, predictive methodology for helicopter cockpit system design that integrates human factors engineering with other principles at an early stage in the development process, avoiding the high cost of previous system design methods. Enabling technologies such as the MIDAS work station are examined, and the potential of low-cost parallel-processing systems is indicated. N.B.

**A90-30728#****AUDITORY LOCALIZATION CUE SYNTHESIS AND HUMAN PERFORMANCE**

MARK A. ERICSON and RICHARD L. MCKINLEY (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 718-725.

Directional audio technology for headphone applications is being developed. A laboratory demonstration model of a real-time digital auditory localization cue synthesizer is integrated with a head position tracker, A/D and D/A converters, and a host computer to form a directional audio display (DIRAD). The DIRAD presents sounds over headphones that are perceived to be outside of the listener's head and relatively easy to localize. Possible military applications of DIRAD include integration with radar warning receivers, voice communication systems, and collision avoidance systems. Performance experiments demonstrated the ability of humans to localize sounds over headphones. Overall mean magnitude errors of 6.0 deg were measured in the control condition and 4.8 deg with the DIRAD. Mean response times of 3.5 sec in the control condition and 4.3 sec with the DIRAD were measured. I.E.

**A90-30731****EFFECTS OF VISUAL DISPLAY SEPARATION UPON PRIMARY AND SECONDARY TASK PERFORMANCES**

RONALD M. KATSUYAMA (Dayton, University, OH), DONALD L. MONK (USAF, Armstrong Aerospace Medical Research Laboratory,

Wright-Patterson AFB, OH), and EVAN P. ROLEK (Systems Research Laboratories, Inc., Dayton, OH) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 758-764.

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Dual task performances were investigated as a function of the location of a peripherally mounted miniature CRT which presented secondary task information. The location of the CRT was varied across three levels of elevation and four levels of azimuth. Primary task information was presented by means of a stationary centrally located CRT. The primary task required continuous monitoring of the primary display, while the secondary task required continuous tracking of an object on the secondary display. The results indicated that (1) performance on both tasks declined as the displays' separation along the azimuth increased; (2) performance decrements were greater when upward eye shifts were required to view the secondary display than when the corresponding downward eye shifts were required; and (3) subjects' ratings of discomfort were similar to the general pattern of performance decrements. The implications of these findings for the design of secondary displays are discussed. I.E.

**A90-30737#**

**THE USE OF LOWER BODY NEGATIVE PRESSURE AS A MEANS OF -GZ PROTECTION**

L. D. TRIPP, B. G. BECK, T. JENNINGS, J. FRAZIER, and T. GORDON (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 794-797. refs

The use of LBNP as a means of increasing -Gz tolerance was investigated. Ten subjects were seated at a zero-degree seatback angle with their heads outward away from the center of rotation in a human centrifuge and exposed to -50 and -100 mm Hg gage pressure, as well as to ambient pressure, while experiencing -1.0, -1.5, and -2.0 Gz plateaus for 30-sec duration. The tests were conducted on the dynamic environment simulator, a three-axis man-rated centrifuge. EKG data showed that significant decreases in heart rates occurred at -2.0 Gz with ambient suit pressure. Comparing the same -Gz level with -100 mm Hg, heart rates increased by 56 percent, indicating that blood was being pooled in the lower body during the -Gz exposure. In addition, subjective data indicated that subjects experienced a decrease in cephalad pressures with the aid of LBNP for all -Gz exposures. LBNP at pressures between -50 to -100 mm Hg appears to be a viable means of counteracting the adverse physiologic effects of -Gz acceleration. I.E.

**A90-30738**

**THE EFFECT OF AN ANTI-BALLOONING G-SUIT AND A BUTTSTRAP G-SUIT ON G-TOLERANCE**

TOM JENNINGS, LLOYD TRIPP, LORA HOWELL (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), DIMITRIOS LOUKOUMIDIS (USAF, Clothing Div., Wright-Patterson AFB, OH), and CHUCK GOODYEAR (Systems Research Laboratories, Inc., Beavercreek, OH) IN: NAECON 89; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 22-26, 1989. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 799-802. refs

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Two modifications introduced in an effort to improve the effectiveness of the USAF CSU-13B/P G-suit for pilots of high-performance aircraft are described: (1) body-contoured pieces of 1/4-inch polypropylene attached over each G-suit bladder to reduce ballooning during suit inflation; and (2) a buttstrap and connecting belts to compress the pilot's buttocks when the G-suit is inflated. Centrifuge tests on pilots wearing standard suits and suits with (1) alone or both (1) and (2) reveal that (1) provides no

significant improvement in G protection, whereas (2) provides a significant improvement of about 0.45 G. Pilots also report that protective straining maneuvers are easier to perform with modification (2). T.K.

**A90-31326**

**HUMAN FACTORS SOCIETY, ANNUAL MEETING, 33RD, DENVER, CO, OCT. 16-20, 1989, PROCEEDINGS. VOLUMES 1 & 2**

Conference sponsored by the Human Factors Society. Santa Monica, CA, Human Factors Society, 1989, p. Vol. 1, 795 p.; vol. 2, 748 p. For individual items see A90-31327 to A90-31329, A90-31331 to A90-31387.

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Aerospace topics presented include spatial awareness and map displays, air traffic control, aviation controls and displays, simulation and decision aiding, and space-related activities. Other major topics addressed are communication, computer systems, environmental design, occupational biomechanics, international technology transfer, and system development. Also addressed are test and evaluation, perspectives on embedded training in military systems, training device design, and visual performance. R.E.P.

**A90-31332**

**SITUATION AWARENESS - ICONS VS. ALPHANUMERIC**

BRUCE A. STEINER and MONICA J. CAMACHO (Lockheed Aeronautical Systems Co., Burbank, CA) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 28-32. refs

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This study examined the effect of varying the amount of information that is presented in either an alphanumeric or iconic display and its effect on how efficiently a pilot can utilize the data. The results from 12 subjects, under self-paced presentation length conditions, indicated that for a small quantity of data (2 or 4 bits) there is no difference in response times between iconic and alphanumeric displays. As the quantity of data presented increases (8, 16, or 32 bits), subjects perform better using iconic displays. Author

**A90-31339\*** Texas Instruments, Inc., Dallas.

**INVESTIGATION OF DISPLAY ISSUES RELEVANT TO THE PRESENTATION OF AIRCRAFT FAULT INFORMATION**

DONALD M. ALLEN (Texas Instruments User Systems Engineering Laboratory, Dallas) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 61-65. Research supported by NASA. refs

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This research, performed as a part of NASA Langley's Faultfinder project, investigated display implementation issues related to the introduction of real time fault diagnostic systems into next generation commercial aircraft. Three major issues were investigated: visual display styles for presenting fault related information to the crew, the form the output from the expert system should take, and methods for filtering fault related information for presentation to the crew. Twenty-four flight familiar male volunteers participated as subjects. Five subjects were NASA test pilots, six were Commercial Airline Pilots, seven were Air Force Lear Jet pilots, and six were NASA personnel familiar with flight (non-pilots). Subjects were presented with aircraft subsystem information on a CRT screen. They were required to identify the subsystems presented in a display and to remember the state (normal or abnormal) of subsystem parameter information contained in the display. The results of the study indicated that in the simpler experimental test cases (i.e., those involving single subsystem failures and composite hypothesis displays) subjects' performance did not differ across the different display formats. However, for the more complex cases (i.e., those involving multiple subsystem faults and multiple hypotheses displays), subjects' performance was superior in the text- and picture-based display formats

compared to the symbol-based format. In addition, the findings suggest that a layered approach to information display is appropriate. Author

**A90-31345**

**THE EFFECT OF INCREASING TASK COMPLEXITY ON THE FIELD-OF-VIEW REQUIREMENTS FOR A VISUALLY COUPLED SYSTEM**

MAXWELL J. WELLS (Systems Research Laboratories, Inc., Dayton, OH) and MICHAEL VENTURINO (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 91-95. refs  
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Ten subjects performed a task on a head-coupled simulator using various sized fields-of-view (FOVs). The task required them to visually acquire, remember the location of, monitor and shoot 3 or 6 objects. In addition they were required to perform a secondary tracking task. Performance at monitoring and shooting the objects decreased with decreasing FOV size and increasing number of objects. Secondary task performance also decreased with decreasing FOV. The ability to recall the location of objects was unaffected by changes in FOV size. However, tracking performance was degraded while subjects used smaller FOVs to find and learn the location of objects. The results indicate that although visual search performance can be maintained with small FOVs, it is done in a manner which may compromise performance at other tasks. Author

**A90-31347**

**GLOBAL TASK MANAGEMENT AS IMPLEMENTED IN HOS-IV**  
HELENE P. IAVECCHIA and REGINA M. HARRIS (Analytics, Inc., Willow Grove, PA) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 101-104. refs  
(Contract MDA903-86-C-0384)  
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The Human Operator Simulator (HOS-IV) is a general purpose simulation tool. It can be used to simulate the dynamic interactions of the environment, the hardware/software system, as well as the operator. HOS-IV provides time and accuracy data for a core set of cognitive, perceptual, and psychomotor processes. The focus of this paper is the HOS-IV mechanism that is used to simulate global task management. A sample application that demonstrates HOS-IV task management is also presented. Author

**A90-31348**

**ON DEVELOPING THEORY-BASED FUNCTIONS TO MODERATE HUMAN PERFORMANCE MODELS IN THE CONTEXT OF SYSTEMS ANALYSIS**

KEVIN BOETTCHER, ROBERT NORTH, and VICTOR RILEY (Honeywell Systems and Research Center, Minneapolis, MN) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 105-109.  
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Preliminary work is described toward the development of moderator functions for systems analysis that reflect human behavioral limitations and tendencies. In particular, a model of human-machine interaction dynamics in complex systems is introduced to give a moderating influence on overall operator/decision aid performance. A key input to this model is the operator's current workload. To further ground the moderator function in human-behavioral considerations, a multiple resource theory-based workload assessment technique is used to provide this input. Author

**A90-31349**

**TASK NETWORK MODELING AS A BASIS FOR ANALYZING OPERATOR WORKLOAD**

K. RONALD LAUGHERY, JR. (Micro Analysis and Design, Boulder, CO) IN: Human Factors Society, Annual Meeting, 33rd, Denver,

CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 110-114. refs  
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This paper discusses a technique for predicting human workload, which is based around task network modeling. Task network modeling allows task analyses to be simulated on a computer to study dynamic system behavior through the addition of information, primarily task time, and sequencing. A technique was developed by McCracken and Aldrich (1984) and modified by Drews et al. (1985) which permits the inclusion of workload information into a task network model. From these workload models, predictions can be made about where points of excessive operator overload are likely to occur. This paper will briefly describe a software tool for using the technique as well as the perceived theoretical shortcomings of the technique in its current form. Author

**A90-31352**

**A GENERAL MODEL OF MIXED-INITIATIVE HUMAN-MACHINE SYSTEMS**

VICTOR RILEY (Honeywell Systems and Research Center, Minneapolis, MN) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 124-128.  
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The increasing role of automation in human-machine systems requires modeling approaches which are flexible enough to systematically express a large range of automation levels and assist the exploration of a large range of automation issues. A General Model of Mixed-Initiative Human-Machine Systems is described, along with a corresponding automation taxonomy, which provides a framework for representing human-machine systems over a wide range of complexity; forms the basis of a dynamic, pseudo-mathematical simulation of complex interrelationships between situational and cognitive factors operating in dynamic function allocation decisions; and can guide methodical investigations into the implications of decisions regarding system automation levels. Author

**A90-31353\*** Lockheed Engineering and Sciences Co., Houston, TX.

**SPEECH VERSUS MANUAL CONTROL OF CAMERA FUNCTIONS DURING A TELEROBOTIC TASK**

JOHN M. BIERSCHWALE, CARLOS E. SAMPAIO, MARK A. STUART, and RANDY L. SMITH (Lockheed Engineering and Sciences Co., Houston, TX) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 134-138. refs  
(Contract NAS9-17900)  
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Voice input for control of camera functions was investigated in this study. Objective were to (1) assess the feasibility of a voice-commanded camera control system, and (2) identify factors that differ between voice and manual control of camera functions. Subjects participated in a remote manipulation task that required extensive camera-aided viewing. Each subject was exposed to two conditions, voice and manual input, with a counterbalanced administration order. Voice input was found to be significantly slower than manual input for this task. However, in terms of remote manipulator performance errors and subject preference, there was no difference between modalities. Voice control of continuous camera functions is not recommended. It is believed that the use of voice input for discrete functions, such as multiplexing or camera switching, could aid performance. Hybrid mixes of voice and manual input may provide the best use of both modalities. This report contributes to a better understanding of the issues that affect the design of an efficient human/teleoperator interface. Author

**A90-31354\*** Brookhaven National Lab., Upton, NY.

**THE EFFECT OF PRESSURE SUIT GLOVES ON HAND PERFORMANCE**

JOHN M. O'HARA (Brookhaven National Laboratory, Upton, NY)

IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 139-143.  
(Contract NAS9-17702)

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The effects of pressure gloves on human hand capabilities is a major concern in the performance of extravehicular activity (EVA) for space maintenance and construction missions. The effects of EVA gloves on six hand performance domains was investigated in this NASA sponsored research. They were range of motion, strength, tactile perception, dexterity, fatigue, and comfort. All tests were designed to be performed in a glove box using the barehand as well as the glove at 0 and 4.3 pressure differentials. Ten subjects participated in the test in a repeated measures design. The results of the experiments are summarized in this paper. Author

**A90-31355\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**USABILITY TESTING AND REQUIREMENTS DERIVATION FOR EMU-COMPATIBLE ELECTRICAL CONNECTORS**

RAY A. REAUX, THOMAS J. GRIFFIN (CTA, Inc., Rockville, MD), and RUTHAN LEWIS (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 144-148. refs

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On-orbit servicing of payloads is simplified when a spacecraft has been designed for serviceability. A key design criterion for a serviceable spacecraft is standardization of electrical connectors. This paper investigates the effects of extravehicular mobility unit (EMU) glove size, connector size, and connector type on usability of electrical connectors. An experiment was conducted exploring participants' ability to mate and demate connectors in an evacuated glovebox. Independent variables were two EMU glove-sizes, five connector size groups, and seven connector types. Significant differences in performance times and heart rate changes during mate and demate operations were found. Subjective assessments of connectors were collected from participants with a usability questionnaire. The data were used to derive design recommendations for a NASA-recommended EMU-compatible electrical connector. Author

**A90-31356\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**NEUTRAL BUOYANCY METHODOLOGY FOR STUDYING SATELLITE SERVICING EVA CREWMEMBER INTERFACES**

MARY E. BARNBY, THOMAS J. GRIFFIN (CTA, Inc., Greenbelt, MD), and RUTHAN LEWIS (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 149-153. refs  
Copyright

Current economic constraints indicate the need for incorporating the satellite servicing philosophy of commonality within the design of spacecraft subsystems. This philosophy is essential for conserving resources including hardware/software development and implementation costs, on-orbit and ground-based manpower, crew training/testing time, and documentation. In addition, spacecraft subsystem commonality may be coupled with standardization of operation procedures, and test and verification techniques for spacecraft design. Several spacecraft have adopted this practice, including Hubble Space Telescope, Space Station Freedom, and the Explorer Platform. As these and other programs continue and if effective crew interfaces and procedures are clearly and consistently defined, crew retraining for similar spacecraft subsystems will lessen, and procurement efforts will diminish. A relatively high fidelity zero-gravity simulation using water immersion is available to establish crew interfaces economically. The flexibility and utility of this space simulation medium for planning and assisting on-orbit operations was exemplified by astronaut evaluations of potential EVA electrical connectors. The testing was conducted at a NASA underwater neutral buoyancy training facility. Author

**A90-31357**

**AN EXPERIMENTAL DETERMINATION OF HUMAN HAND ACCURACY WITH A DATAGLOVE**

DAVID L. QUAM, PATRICIA C. BROWNE, JEFFERY R. AGNEW (MacAulay-Brown, Inc., Dayton, OH), and GEORGE B. WILLIAMS (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 315-319.  
(Contract F33615-87-C-0534; F33615-85-C-0541)

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A three-part experiment was conducted to determine the accuracy, repeatability and linearity of a human hand manipulating the DataGlove. Accuracy and repeatability of finger flexure were investigated with repeated measurements of three calibration positions. Linearity of finger flexure was investigated with steady finger and thumb curling motions. Accuracy and repeatability of hand location and orientation were investigated with repeated measurements of six hand positions. Finger flexure mean accuracy was 6 deg for the four fingers and 11 deg for the thumb, repeatability was 3 deg for the four fingers and 9 deg for the thumb, and linearity varied from 2 to 5 deg. Although the mean location accuracy was 1 inch and the mean orientation accuracy was 17 deg, the position and orientation receiver was observed to twist on the glove back. Across all subjects, the location repeatability was 0.5 inch, while the orientation repeatability was 9 deg. The within-subject location repeatability was 0.13 inches, while the orientation repeatability was 2 deg. Author

**A90-31358**

**OPERATOR BEHAVIORAL BIASES USING HIGH-RESOLUTION TOUCH INPUT DEVICES**

DENNIS B. BERINGER and MARY JAMES BOWMAN (New Mexico State University, Las Cruces) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 320-322. refs

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In the present study the effects of screen angle relative to line of sight and positioning of targets were examined with a high-resolution (1 pixel or about 1/12 mm) resistive touch input device thought to have minimal parallax. Results replicated earlier findings of Beringer and Peterson (1985) in that a 17-degree declination of the touch surface below orthogonal to line of sight induced a high-touch bias error of 9 pixels (about 3/4 mm) whereas orthogonality of the interface to line of sight virtually eliminated bias. Both software and behavioral compensation strategies are discussed. Author

**A90-31361\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**CREW QUARTERS FOR SPACE STATION**

F. E. MOUNT (NASA, Johnson Space Center, Houston, TX) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1989, p. 531-535. refs

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The only long-term U.S. manned space mission completed has been Skylab, which has similarities as well as differences to the proposed Space Station. With the exception of Skylab missions, there has been a dearth of experience on which to base the design of the individual Space Station Freedom crew quarters. Shuttle missions commonly do not have sleep compartments, only 'sleeping arrangements'. There are provisions made for each crewmember to have a sleep restraint and a sleep liner, which are attached to a bulkhead or a locker. When the Shuttle flights began to have more than one working shift, crew quarters became necessary due to noise and other disturbances caused by crew task-related activities. Shuttle missions that have planned work shifts have incorporated sleep compartments. To assist in gaining more information and insight for the design of the crew quarters for the Space Station Freedom, a survey was given to current crewmembers with flight experience. The results from this survey

were compiled and integrated with information from the literature covering space experience, privacy, and human-factors issues.

Author

#### A90-31371

##### **A LABORATORY SIMULATION OF SELECTED IN-FIELD INFLUENCES ON HEARING PROTECTOR PERFORMANCE**

M. Y. PARK and J. G. CASALI (Virginia Polytechnic Institute and State University, Blacksburg) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 946-950. refs

(Contract NIH-1-R01-OH-0254-01)

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The study concentrates on the effects of work related factors, including wearing time, movement activity, and fitting procedure, on the frequency-specific attenuation achieved with a foam cushion earmuff, two types of earplugs, and an earmuff over foam earplug combination. Using a real-ear-attenuation-at-threshold testing procedure, attenuation data are collected from 40 subjects at nine test frequencies. Occluded thresholds are obtained before, during, and after the movement activity task, so that effects of wearing time and task activity may be determined. The results indicate that achieved attenuation is decreased as a function of time, and that trained fit provides greater attenuation than subject fit without training. The influence of in-field factors on hearing protector effectiveness is assessed. V.T.

#### A90-31376

##### **DISCRIMINABILITY OF COLOR SYMBOLS THROUGH PLZT GOGGLES**

GILBERT G. KUPERMAN, DENISE L. WILSON (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), and ROBYN CRAWFORD (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1378-1382. refs

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The paper describes a symbol recognition experiment conducted to determine how far apart in color space symbol and background colors must be in order for symbols to be reliably recognized. Spectral transmittance data show a reduction of 78 percent in display luminance to the operator wearing PLZT goggles. All chromaticities are found to shift markedly toward green when measured through the goggles. The effects of the PLZT goggles on the symbol recognition task are lessened as the symbol-to-background chromaticity distance is increased. The results support the development of specialized color display symbol sets in workplaces where PLZT flashblindness protection is worn by the operator. V.T.

#### A90-31377

##### **SPATIAL AWARENESS WITH A HELMET-MOUNTED DISPLAY**

MICHAEL VENTURINO (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and RICHARD J. KUNZE (Missouri, University, Columbia) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1388-1391.

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The ability of a human being to acquire and memorize the spatial locations of stimulus targets using a helmet mounted display is analyzed. The size of the field of view (FOV) on the helmet mounted display and the memory load are manipulated in a two-phase search and replace task employed in the experiment. The results show that search time increases significantly as the size of the FOV becomes smaller and the subjects' ability to replace a stimulus target in its original location in space is adversely affected by increases in memory load. The size of the FOV is shown to affect one's ability to acquire spatial information of one's surroundings, but once this information has been mapped into spatial memory, humans can use that information independently of the size of the display. A subject's spatial memory has some

limitations, however, since the ability to remember precise locations becomes poorer as the amount of information to remember increases. V.T.

A90-31378\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

##### **VISUAL DIRECTION AS A METRIC OF VIRTUAL SPACE**

STEPHEN R. ELLIS, STEPHEN SMITH, and SELIM HACISALIHZADE (NASA, Ames Research Center, Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1392-1395. refs

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Two experiments examine the abilities of ten subjects to visualize directions shown on a perspective display. Subjects indicated their perceived directions by adjusting a head-mounted cursor to correspond to the direction depicted on the display. This task is required of telerobotic operators who use map-like pictures of their workspace to determine the direction of objects seen by direct view. Results show significant open-loop judgment biases that may be composed of errors arising from misinterpretation of the map geometry and overestimation of gaze direction. Author

#### A90-31380

##### **EFFECTS OF VARIATIONS IN HEAD-UP DISPLAY PITCH-LADDER REPRESENTATIONS ON ORIENTATION RECOGNITION**

WILLIAM R. ERCOLINE (Systems Research Laboratories, Inc., Brooks AFB, TX), KENT K. GILLINGHAM, FRANCES A. GREENE, and FRED H. PREVIC (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1401-1405. refs

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Head-up display (HUD) research has centered on modifications to the basic aircraft control symbology - the pitch-ladder lines. Although some of these modifications have led to minor improvements in attitude recognition, major problems still exist: pilots continue to experience spatial disorientation and to complain of occlusion due to the HUD symbols. This experiment compared four variations of a basic HUD pitch ladder: Display A, double articulation; Display B, single negative articulation; Display C, single negative articulation with gradually increasing thickness; and Display D, single negative articulation with gradually increasing thickness in a global arrangement. Accuracy of bank recognition was best when pitch-ladder symbology incorporated noticeable asymmetry. Double articulation and graduated thickness were associated with greater accuracy of pitch recognition. Studies under dynamic conditions are recommended. Author

#### A90-31382

##### **HUE AND DISPARITY INTERACTIONS IN ADVANCED STEREOSCOPIC AIRCRAFT DISPLAYS**

JAMES E. MCCLAIN (USAF, Operational Test and Evaluation Center, Kirtland AFB, NM) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1422-1426. refs

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The interaction of chromostereopsis and artificially stimulated stereopsis on a stereoscopic CRT is evaluated by determining the level of accuracy with which subjects can properly interpret the relative depth differences of adjacent symbols containing one of a combination of six levels of hue and stereoscopic disparities. It is shown that chromostereopsis can significantly affect the stereoscopic perception of depth on a stereoscopic display when disparity levels are relatively small. It is suggested that caution be used when choosing hues to represent three-dimensional images located in close proximity on a stereoscopic three-dimensional display, especially when considering the use of hues near either end of the frequency spectrum. It is also suggested that adjacent symbols with stereoscopic disparity differences between them of

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3.39 arc minutes or less avoid the use of colors on extreme ends of the frequency spectrum unless they are intended to consistently enhance or negate depth perception represented by stereoscopic disparity. V.T.

**A90-31383\*** Lockheed Engineering and Sciences Co., Houston, TX.

### **THE EFFECTS OF SPATIALLY DISPLACED VISUAL FEEDBACK ON REMOTE MANIPULATOR PERFORMANCE**

RANDY L. SMITH and MARK A. STUART (Lockheed Engineering and Sciences Co., Houston, TX) IN: Human Factors Society, Annual Meeting, 33rd, Denver, CO, Oct. 16-20, 1989, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1989, p. 1430-1434. refs

(Contract NAS9-17900)

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The effects of spatially displaced visual feedback on the operation of a camera viewed remote manipulation task are analyzed. A remote manipulation task is performed by operators exposed to the following different viewing conditions: direct view of the work site; normal camera view; reversed camera view; inverted/reversed camera view; and inverted camera view. The task completion performance times are statistically analyzed with a repeated measures analysis of variance, and a Newman-Keuls pairwise comparison test is administered to the data. The reversed camera view is ranked third out of four camera viewing conditions, while the normal viewing condition is found significantly slower than the direct viewing condition. It is shown that generalization to remote manipulation applications based upon the results of direct manipulation studies are quite useful, but they should be made cautiously. V.T.

**N90-18873#** Anthropology Research Project, Yellow Springs, OH.

### **ANTHROPOMETRY OF A FIT TEST SAMPLE USED IN EVALUATING THE CURRENT AND IMPROVED MCU-2/P MASKS Summary Report, Aug. 1987 - Mar. 1989**

HENRY CASE, CAV ERVING, and KATHLEEN M. ROBINETTE Mar. 1989 38 p

(Contract F33615-85-C-0531)

(AD-A215173; AAMRL-TR-89-009) Avail: NTIS HC A03/MF A01 CSDL 05/8

Forty-two head and face dimensions were measured on a fit-test sample of 104 subjects employed to evaluate current and improved models of the Air Force MCU-2/P full-face protective mask. The object of the study was to determine whether the sample was anthropometrically representative of the larger Air Force population. Fitting criteria currently in use were also evaluated. Results of the study indicated that head and face dimensions of the male test sample reflected the distribution among male Air Force personnel. Though selected with similar care, the female sample was, on the whole, somewhat larger than the Air Force females. Quantitative fit testing showed that both masks could be successfully fitted to all but one subject. However, marked differences in measurement results by two teams of measures call into question the choice of sizing categories, mask issue criteria, and tariffing. Further investigation is recommended. GRA

**N90-18874#** Army Aeromedical Research Lab., Fort Rucker, AL.

### **EVALUATION OF HELMET RETENTION SYSTEMS USING A PENDULUM DEVICE Final Report**

PETER VYRNWY-JONES, CHARLES R. PASCHAL, JR., and RONALD W. PALMER Sep. 1989 56 p

(AD-A215489; USAARL-89-27) Avail: NTIS HC A04/MF A01 CSDL 05/8

Three methods were evaluated for testing the retention and rotation characteristics of aircrew helmets. Two of these employed static techniques with an anthropometric headform and human subjects. Unfortunately, though simple in execution, these tests were insensitive to the mass and mass distribution of the helmets. However, the third method, the pendulum beam Department of Transportation testing device proved to be a simple and efficient

means of differentiating between the various helmets. This method should have a role in the development and testing of future U.S. Army aircrew helmets. GRA

**N90-18875#** Systems Control Technology, Inc., Arlington, VA. **HUMAN FACTORS ISSUES IN AIRCRAFT MAINTENANCE AND INSPECTION Final Report**

WILLIAM T. SHEPHERD and JAMES F. PARKER, JR. Oct. 1989 117 p

(Contract DTFA01-87-C-00014)

(AD-A215724; SCT-89-RR-18; DOT/FAA/AM-89/9) Avail: NTIS HC A06/MF A01 CSDL 01/3

The Federal Aviation Administration sponsored a two-day meeting in October 1988 to address issues of human factors and inspection. Presentations were given by some 13 individuals representing the full spectrum of interests in commercial aviation. Presentations also were given by three human factors scientists with backgrounds in vigilance and industrial inspection technology. Each presentation, as well as the following question and answer period, was recorded for transcription and study. The objective of the meeting was to identify human issues of importance, particularly as such issues might contribute to inspection or maintenance error. The desired outcome was to be: (1) an improved understanding of personnel performance in aviation maintenance, and (2) recommendations, as appropriate, to the FAA concerning needed research efforts and/or possible new or revised regulatory actions. Several recommendations were presented to the FAA in the areas of communications, training, management, regulatory review, and research and development. GRA

**N90-18876#** Oak Ridge National Lab., TN. Telerobotic Systems Section.

### **TELEOPERATOR SERVOLOOP TUNING USING AN EXPERT SYSTEM**

M. W. NOAKES 1990 4 p Presented at the 22nd IEEE Southeastern Symposium on System Theory, Cookeville, TN, 11-13 Mar. 1990

(Contract DE-AC05-84OR-21400)

(DE90-005674; CONF-900378-3) Avail: NTIS HC A01/MF A01

This paper discusses the development of an expert system for optimizing of the controls tuning of a gear and shaft force-reflecting servomanipulator. Remote maintenance techniques have produced hot-cell manipulators that do not require hands-on repair. However, these manipulators are difficult to tune due to the conflicting priorities of maximizing operator sensation of force reflection and minimizing operator fatigue in combination with the complex nonlinear control algorithms and cross-coupled motions. Due to the heuristic nature of this tuning problem and the emphasis on human perception of performance, an expert system has been developed as an alternative to algorithmic optimization of gains. DOE

**N90-19743#** Army Test and Evaluation Command, Aberdeen Proving Ground, MD.

### **HUMAN FACTORS ENGINEERING TESTING OF AIRCRAFT COCKPIT LIGHTING SYSTEMS Final Report**

2 Aug. 1989 28 p

(AD-A216853; TOP-7-2-513) Avail: NTIS HC A03/MF A01 CSDL 01/3

The procedures, test equipment and facilities are specified to perform tests and evaluations of aircraft cockpit lighting systems. The topics include display luminance, illuminance, contrast, balance, uniformity, sunlight readability, display color, night vision goggle compatibility, crewstation reflections and mockup evaluations. These procedures are closely tied to U.S. Army lighting requirements. GRA

**N90-19744#** Los Alamos National Lab., NM. Dept. of Earth and Environmental Sciences.

### **WORKING ON THE MOON: THE APOLLO EXPERIENCE**

ERIC M. JONES 1989 11 p Presented at the Engineering, Construction and Operations for Space, Albuquerque, NM, Apr. 1990

(Contract W-7405-ENG-36)  
(DE90-003662; LA-UR-89-3858; CONF-900442-3) Avail: NTIS  
HC A03/MF A01

The successful completion of any scientific or engineering project on the moon will depend, in part, on human ability to do useful work under lunar conditions. In making informed decisions about such things as the use of humans rather than robots for specific tasks, the scheduling of valuable human time, and the design and selection of equipment and tools, good use can be made of the existing experience base. During the six completed landing missions, Apollo lunar surface crews conducted 160 astronaut-hours of extra-vehicular activities (EVAs) and also spent a similar sum of waking hours working in the cramped confines of the Lunar Module. The first three missions were primarily proof-tests of flight hardware and procedures. The ability to land equipment and consumables was very modest but, despite stay times of no more than 32 hours, the crews of Apollos 11, 12, and 14 were able to test their mobility and their capability of doing useful work outside the spacecraft. For the last three missions, thanks to LM modifications which enabled landings with significant amounts of cargo, stay times more than doubled to three days. The crews were able to use Lunar Rovers to conduct extensive local exploration and to travel up to 10 kilometers away from their immediate landing sites. DOE

**N90-19745#** Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.

**AN APPROACH TO ELEMENTAL TASK LEARNING**

PHILIPPE BELMANS 1990 11 p Presented at the 8th SPIE Applications of Artificial Intelligence Conference, Orlando, FL, 17-19 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-006614; CONF-9004125-1) Avail: NTIS HC A03/MF A01

In this article we deal with the automated learning of tasks by a robotic system through observation of a human operator. Particularly, we explain what is meant by a learning ability in autonomous robots and in teleoperation systems, where several operators and several machines may work in cooperation to perform tasks. We discuss different approaches to learning in these systems and outline the features of the models they are based upon. This leads us to choose an analytical model suited for tasks analysis. We then present the software architecture for our proposed approach and show the first results obtained on sample tests. DOE

**N90-19746#** Oak Ridge National Lab., TN.

**A HUMAN FACTORS TESTBED FOR GROUND-VEHICLE  
TELEROBOTICS RESEARCH**

G. K. CORBETT, S. M. KILLOUGH, B. S. RICHARDSON, and M. HERMAN (National Inst. of Standards and Technology, Gaithersburg, MD.) 1990 4 p Presented at the IEEE Southeastcon, New Orleans, LA, 1-4 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-006618; CONF-900464-4) Avail: NTIS HC A01/MF A01

A human factors testbed has been designed for the U.S. Army Human Engineering Laboratory to experiment in the area of remote control of wheeled vehicles. The testbed's capabilities have been demonstrated by remotely driving a high maneuverability and mobility wheeled vehicle (HMMWV). Details of testbed design and experiments are presented. DOE

**N90-19747#** Oak Ridge Gaseous Diffusion Plant, TN.

**REPORT OF THE FIRST ANNUAL AIRBORNE WEAPONS  
TRAINING TECHNOLOGY REVIEW**

CATHRINE E. SNYDER, ed., GAIL B. PAYNE, ed., and INGA E. TREITLER, ed. (Tennessee Univ., Knoxville.) Jan. 1990 56 p Review held in Oak Ridge, TN, 29-31 Mar. 1989

(Contract DE-AC05-84OT-21400)

(DE90-007189; K/DSRD-119) Avail: NTIS HC A04/MF A01

The First Annual Airborne Weapons Training Technology Review is documented. It was an exchange of ideas and information among the members of the network supporting the Naval Air Systems Command's (NAVAIR's) PMA205-11, Program Manager

for Ordnance Training. The briefings and demonstrations presented at the Review are described, and the discussion at the informal caucus where significant issues were raised from the first two days' presentations are summarized. The meeting agenda, a participant list with addresses and telephone numbers, a list of the Department of Defense activities represented, NAVAIR's follow-up communication, and a brief description of Martin Marietta Energy Systems, Inc.'s training technology project support are presented. A broad range of topics related to training systems and training support was covered during the Review. Synopses of the presentations and demonstrations included here cover computer-based and interactive systems, portability of software, reuse of training systems for different weapons, standardization of trainers, instructional systems design, cognitive task analysis, tracking of training resources, and the application of Computer-aided Acquisition and Logistic Support. DOE

**N90-19748#** Douglas Aircraft Co., Inc., Long Beach, CA.  
**ASSESSMENT OF CREW WORKLOAD MEASUREMENT  
METHODS, TECHNIQUES AND PROCEDURES. VOLUME 2:  
GUIDELINES FOR THE USE OF WORKLOAD ASSESSMENT  
TECHNIQUES IN AIRCRAFT CERTIFICATION Final Report,  
Jul. 1986 - Feb. 1989**

WILLIAM H. CORWIN, DIANE L. SANDRY-GARZA, MICHAEL A. BIFERNO, and GEORGE P. BOUCEK, JR. 12 Sep. 1989 51 p Prepared in cooperation with Boeing Commercial Airplanes, Seattle, WA Sponsored in part by FAA

(Contract F33615-86-C-3600; AF PROJ. 2403)

(AD-A217067; WRDC-TR-89-7006-VOL-2) Avail: NTIS HC  
A04/MF A01 CSCL 05/9

The purpose of Volume 2 is to present specific guidelines and recommendations for evaluating workload certification plans. No attempt is being made to provide a list of simple-to-follow directions for the generation of an aircraft workload certification plan, as this is the responsibility of the manufacturer. The workload assessment techniques are discussed by domain area: Subjective, Physiological, Performance, and Analytic techniques. The distinction by domain is convenient because of the methods and equipment in common among techniques within a domain. Evaluation criteria for assessing a workload certification plan includes treatment of the validity, reliability, and applicability of candidate workload measures. For a workload measure to demonstrate validity, it must be able to discriminate among varying task demands imposed upon the flightcrew. In order for a measure to demonstrate reliability, it should provide the same results with repeated applications. Applicability is simply the ability for workload to be assessed in an aircraft flightdeck environment. GRA

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### SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

**A90-28744\*** California Univ., Santa Cruz.

**COULD ORGANIC MATTER HAVE BEEN PRESERVED ON  
MARS FOR 3.5 BILLION YEARS?**

ANASTASSIA KANAVARIOTI (California, University, Santa Cruz) and ROCCO L. MANCINELLI (NASA, Ames Research Center, Moffett Field, CA) Icarus (ISSN 0019-1035), vol. 84, March 1990, p. 196-202. refs

(Contract NCA2-289; NCC2-479)

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About 3.5 Gyr ago, when it is thought that Mars and earth had similar climates, biological evolution on earth had made considerable progress, such that life was abundant. It is therefore surmised that prior to this time period, the advent of chemical evolution and subsequent origin of life occurred on earth and may have occurred on Mars. Analysis for organic compounds in the soil buried beneath the Martian surface may yield useful

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information regarding the occurrence of chemical evolution and possibly biological evolution. Calculations based on the stability of amino acids lead to the conclusion that remnants of these compounds, if they existed on Mars 3.5 Gyr ago, might have been preserved buried beneath the surface oxidizing layer. For example, if phenylalanine, an amino acid of average stability, existed on Mars 3.5 Gyr ago, then 1.6 percent would remain buried today. Martian soil may exist from remnants of meteoritic and cometary bombardment, assuming that 1 percent of the organics survived impact. Author

**A90-30616\*** California Univ., Los Angeles.

### **ISOTOPIC CHARACTERISTICS OF SIMULATED METEORITIC ORGANIC MATTER. I - KEROGEN-LIKE MATERIAL**

JOHN F. KERRIDGE (California, University, Los Angeles), RUTH MARINER, JOSE FLORES, and SHERWOOD CHANG (NASA, Ames Research Center, Moffett Field, CA) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 19, no. 6, 1989, p. 561-572. refs  
(Contract NAGW-347)  
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*Carbonaceous residues from a variety of laboratory syntheses yield release patterns for C and H isotopes during stepwise combustion that fail to mimic the striking patterns characteristic of meteoritic kerogen-like residues that otherwise superficially resemble them. It seems likely that the meteoritic material comprises a complex mixture of substances having different origins and/or synthesis conditions.* Author

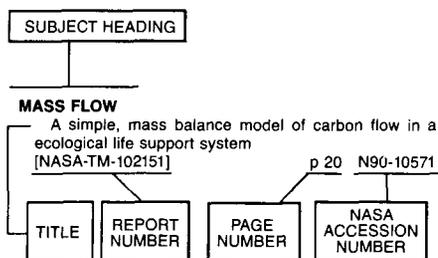
**N90-19749** Maharishi International Univ., Fairfield, IA.

### **THE EFFECTS OF COLD DARK MATTER ON BIG BANG NUCLEOSYNTHESIS Ph.D. Thesis**

RONALD JOHN DAVID PARKER 1989 134 p  
Avail: Univ. Microfilms Order No. DA8918486

The annihilation of cold, weakly-interacting dark matter candidates ( $\chi$ ) subsequent to  $\chi\chi$  freeze-out can significantly affect the primordial abundance of light elements. The largest effects are between the  $n/p$  freeze-out temperature and the onset of nucleosynthesis at  $T$  is approximate or equal to 0.1 MeV,  $\chi\chi$  annihilations increase the  $n/p$  ratio, leading to increased He-4 production; following He-4 synthesis, baryonic products of  $n$ ,  $n(-)$ , and  $p(-)$  of  $\chi\chi$  annihilations dissociate some of the He-4 into D and He-3, leading to increased D + He-3 abundances; toward the end of nucleosynthesis, neutrons from  $\chi\chi$  annihilation lead to  $n + \text{Be-7}$  yields  $p + \text{Li-7}$ , resulting in increased Li-7 + Be-7 production for low values of  $\eta$  is equivalent to  $n(\text{sub } b)/n(\text{sub } \gamma)$  and decreased Li-7 + Be-7 production for large  $\eta$ ; and long after nucleosynthesis, once the universe cools below  $T$  approximately equal to 1 keV, the electromagnetic shower produced by electrons, positrons, and photons from residual  $\chi\chi$  annihilations cause further dissociation of He-4, leading to increased CD + He-3 abundances. The most important result is that for Direc and Majorna neutrinos, the Li-7 constraints on  $\eta$  from the Standard Big Band Nucleosynthesis (SBBN) are noticeably affected, with larger values of  $\eta$  being favored. A summary of scattering rates for processes in the electromagnetic shower, containing corrections to numerous misprints in other sources is presented. A listing of FORTRAN code used in the shower calculations is also included. Dissert. Abstr.

## Typical Subject Index Listing



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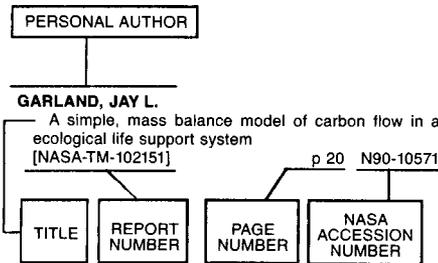
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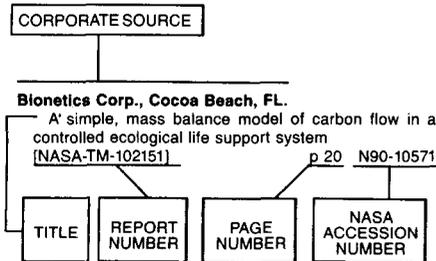
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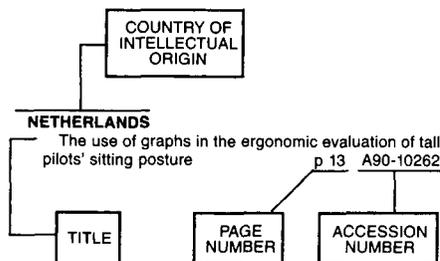
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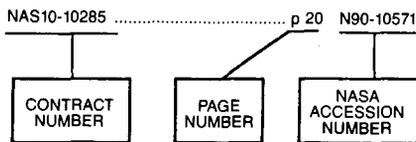
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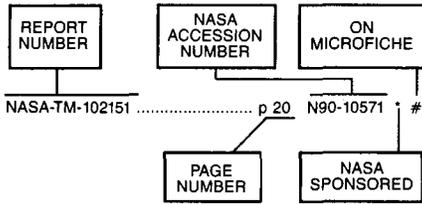


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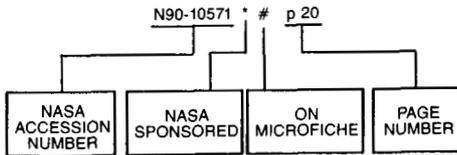


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