NASA SP-7011 (347)
March 1991

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

NASA STI PROGRAM
SCIENTIFIC & TECHNICAL INFORMATION

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National Aeronautics and Space Administration
Office of Management
Scientific and Technical Information Program
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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 166 reports, articles and other documents originally announced in February 1991 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).* The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N91-11666 — N91-13398
IAA (A-10000 Series)	A91-12945 — A91-16992

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

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

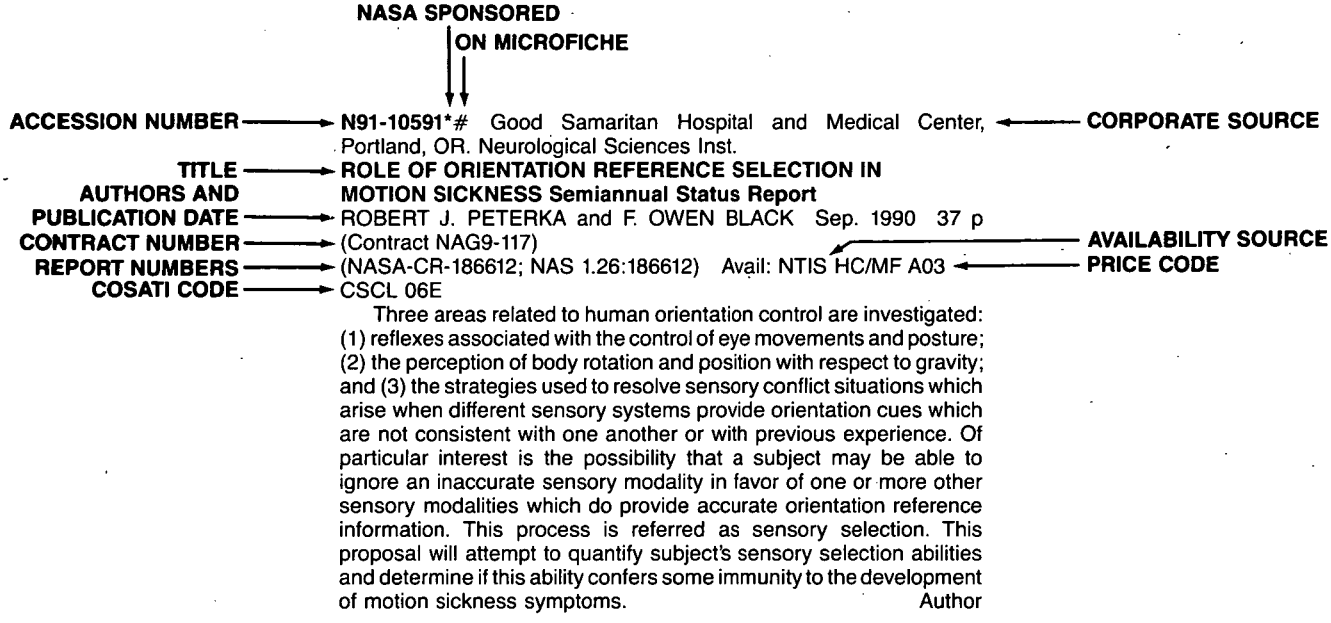
Seven indexes—subject, personal author, corporate source, foreign technology, contract, report number, and accession number—are included.

A cumulative index for 1991 will be published in early 1992.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

TABLE OF CONTENTS

TYPICAL REPORT CITATION AND ABSTRACT



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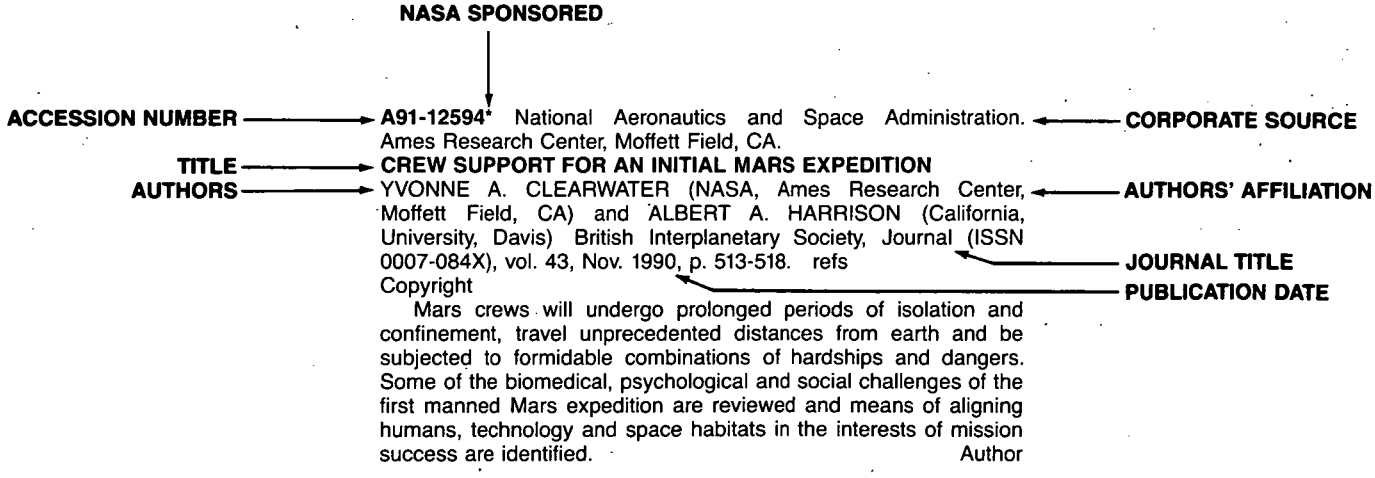

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 347)

MARCH 1991

51

LIFE SCIENCES (GENERAL)

A91-13021
VENTILATORY RESPONSES TO CHEMORECEPTOR STIMULATION AFTER HYPOXIC ACCLIMATIZATION IN AWAKE GOATS
M. J. A. ENGWALL and G. E. BISGARD (Wisconsin, University, Madison) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Oct. 1990, p. 1236-1243. refs
(Contract NIH-HL-15473)
Copyright

The sensitivity of the central and peripheral chemoreceptors to chemical stimuli before and after four hours of either isocapnic or poikilocapnic hypoxia is studied in order to test the hypothesis that exposure to prolonged hypoxia results in altered responsiveness to chemoreceptor stimulation. It is confirmed that arterial P(CO2) decreases progressively, reaching a stable value after four hours of hypoxic exposure, and that acclimatization occurs in both groups. Goats exposed to isocapnic hypoxia exhibit an increased slope of the CO2 response curve, while goats exposed to poikilocapnic hypoxia have no increase in slope but exhibit a parallel leftward shift of the curve. Both groups demonstrate a similar significant increase in the ventilatory response to subsequent acute exposure to isocapnic hypoxia. V.T.

A91-13022
GABA ANTAGONISM REVERSES HYPOXIC RESPIRATORY DEPRESSION IN THE CAT
JOSEPH E. MELTON, JUDITH A. NEUBAUER, and NORMAN H. EDELMAN (New Jersey, University of Medicine and Dentistry, New Brunswick) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Oct. 1990, p. 1296-1301. refs
(Contract NIH-HL-16022)
Copyright

The role of gamma-aminobutyric acid (GABA) as a potential causative agent of hypoxic respiratory depression is evaluated by monitoring the response of the phrenic neurogram to systemic infusion of the GABA antagonist bicuculline under control conditions and during isocapnic brain hypoxia in separate groups of cats. The effect of bicuculline in subseizure doses is observed, as well as in seizure stages. It is pointed out that bicuculline is capable of reversing the depression of the phrenic neugram by restoration of both peak phrenic amplitude and phrenic firing frequency. This reversal of phrenic depression by bicuculline during hypoxia is consistent with the opinion that increased brain extracellular GABA is a major cause of hypoxic respiratory depression and that such a depression is caused by neuronal hyperpolarization. V.T.

A91-13023* Texas Univ., Houston.
CENTRIFUGAL INTENSITY AND DURATION AS COUNTERMEASURES TO SOLEUS MUSCLE ATROPHY
DOMINICK S. D'AUNNO, DONALD B. THOMASON, and FRANK W. BOOTH (Texas, University, Medical School, Houston) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Oct. 1990, p. 1387-1389. refs
(Contract NAG2-239; NAGW-70)
Copyright

The effects of artificially induced gravity on the atrophy process of slow-twitch soleus muscle are studied in order to determine whether centrifugation could be an effective countermeasure to nonweight bearing at 1 G. It is observed that the soleus muscle atrophied 32 percent during seven days of nonweight bearing without countermeasures, and centrifugation treatment did not completely prevent atrophy relative to precontrol wet weight of the soleus muscle. Nonweight-bearing groups receiving treatments of 1, 1.5, or 2.6 G had 48, 56, and 65 percent, respectively, of the atrophy observed in a nonweight-bearing-only group compared with the precontrol group. It is concluded that, as a countermeasure to nonweight-bearing-induced atrophy of the soleus muscle, centrifugation at 2.6 G is no more effective than exposure to 1 or 1.5 G. V.T.

A91-13719
EFFECTS OF SPACE-FLIGHT FACTORS ON THE CENTRAL NERVOUS SYSTEM: THE STRUCTURAL AND FUNCTIONAL ASPECTS OF RADIOMODIFYING EFFECTS [DEISTVIE FAKTOROV KOSMICHESKOGO POLETA NA TSENTRAL'NUIU NERVNUIU SISTEMU: STRUKTURNO-FUNKTSIONAL'NYE ASPEKTY RADIOMODIFITSIRUIUSHCHEGO VLIIANIIA]
VSEVOLOD V. ANTIPOV, BORIS I. DAVYDOV, IGOR' B. USHAKOV, and VLADIMIR P. FEDOROV Leningrad, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Volume 66), 1989, 329 p. In Russian. refs
Copyright

The monograph describes laboratory experiments carried out on mice, rats, cats, and dogs to investigate the effects of space-flight conditions on the structure and function of the central nervous system (CNS). Results are presented on changes occurring in various regions of the brain under the effects of ionizing and nonionizing radiation, hypoxia, hyperoxia, physical overloads, vibration, and several combinations of these factors. Special attention is given to the evaluation of synergistic, antagonistic, and additive effects on the CNS of physical stressors combined with radiation. I.S.

A91-14065#
THE C.E.B.A.S.-AQUARACK PROJECT - THE LABORATORY PROTOTYPE AND FIRST RESULTS OF THE SCIENTIFIC FRAME PROGRAM
V. BLUEM (Bochum, Ruhr-Universitaet, Federal Republic of Germany) and K. KREUZBERG (Deutsche Agentur fuer Raumfahrtangelegenheiten GmbH, Bonn, Federal Republic of Germany) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 10 p. refs
(Contract BMFT-01-QV-85474; BMFT-01-QV-87180; BMFT-01-QV-88466)
(IAF PAPER 90-522) Copyright

The paper explains the basic conception of a Closed Equilibrated Biological Aquatic System incorporated in an Aquarack as a research tool for zoological, botanical, and interdisciplinary research in space biology. The construction principle of a laboratory prototype consisting of a modular habitat for aquatic animals, a semi-biological/physical water recycling system, and a

computerized control unit is described. The scientific program as is presented, including subtopics reproductive biology, genetics, embryology/teratology, neurobiology, vestibular research, stress research general endocrinology, ethology, gerontology, and skeleton research. The choice of experimental animals is explained. Author

A91-14066#
THE EFFECT OF SPACE FLIGHT ON THE OF BOARD THE SATELLITE COSMOS 2044 ON PLASMA HORMONE LEVELS AND LIVER ENZYME ACTIVITIES OF RATS
L. MACHO, M. FICKOVA, S. NEMETH, E. SVABOVA (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia), L. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 5 p. refs
(IAF PAPER 90-524) Copyright

An investigation aboard the Cosmos 2044 satellite studied the effects of a 14 day space flight on adult male Wistar rats. Changes in the levels of corticosterone, insulin and glucose in the plasma were monitored. The activity of enzymes involved in amino acid metabolism in the liver and also the binding of insulin to specific receptors of cell membrane from both the liver and adipose tissue were studied. The rats were divided into five control groups, including intact control rats, rats exposed to space flight, animals in synchronous model experiment, rats in antiorthostatic hypokinesia, and a control group. Experimental results suggest the presence of deterioration of tissue sensitivity to insulin and a failure of the liver and adipocyte insulin receptors to respond to the increased plasma insulin levels by down regulation. Changes in liver enzyme activities in rats after 14-day space flight are in agreement with the results observed in previous experiments after a shorter space flight. L.K.S.

A91-14067#
CHANGES IN CHROMATIN AND NUCLEIC ACIDS IN RAT TISSUES AFTER TWO-WEEK SPACEFLIGHT
E. MISUROVA and K. KROPACOVA (Univerzita Pavla Josefa Safarika, Kosice, Czechoslovakia) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 5 p. refs
(IAF PAPER 90-525) Copyright

The quantitative changes in nucleic acids and chromatin breakdown were followed in blood, thymus and spleen in rats after 14 day flights onboard the biosatellites Cosmos-1887 and Cosmos-2044. Quantitative nucleic acid changes within 8-11 hours after landing were only mild, mostly statistically nonsignificant. An analysis 48 hours after landing showed a marked decrease in a total content of DNA and RNA in spleen and thymus. Within 8-11 hours after landing the symptoms of chromatin breakdown were found as is seen in an increased concentration of its fragments - polydeoxyribonucleotides. The results show that a partial adaptation to microgravity occurs up to flight day 14 in lymphoid organs. Adaptation is accompanied with a reappearing of the sensitive cells. Their chromatin breaks down, then, in a final phase of flight due to hypergravity stress manifesting itself by a temporary increase in polydeoxyribonucleotide concentration several hours after landing. The results are discussed in relation to the changes in chosen parameters after shorter or more prolonged flights. Author

A91-14068*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LIFE SCIENCES RESEARCH USING A LUNAR LABORATORY
LEONARD F. CIPRIANO (NASA, Ames Research Center; Lockheed Engineering and Sciences Co., Moffett Field, CA) and RODNEY W. BALLARD (NASA, Ames Research Center, Moffett Field, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 10 p. refs
(IAF PAPER 90-530) Copyright

The necessity for life sciences research on the lunar surface in order to determine the consequences of returning from extended missions in various low gravity environments and of transiting through high multiple gravity forces during decelerations is discussed. The functions of a lunar gravitational biology laboratory are outlined. Lunar science objectives include investigations in developmental biology including the evaluation of the capacity of diverse organisms to undergo normal development and the evaluation of the use of the lunar environment to study specific developmental phenomena in ways that cannot be accomplished by earth-based research. The need for musculoskeletal studies to examine the dynamics of osteoclast and osteoblast formation and breakdown and to address bone and demineralization problems is discussed. Biological adaptation to hypogravic environments and the effects of radiation and electromagnetic environmental factors are also considered. L.K.S.

A91-14072*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADIATION BIOLOGY OF HZE PARTICLES
GREGORY A. NELSON (JPL, Pasadena, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 7 p. refs
(IAF PAPER 90-548) Copyright

The biological effects of heavy charged particle (HZE) radiation are of particular interest to travellers and planners for long duration space flights where exposure levels represent a potential health hazard. The unique feature of HZE radiation is the structured pattern of its energy deposition in targets which may be related to charge, velocity, or rate of energy loss. There are many consequences of this feature to biological endpoints when compared to effects of ionizing photons. Dose vs response and dose rate kinetics are modified, DNA and cellular repair systems are altered in their abilities to cope with damage and, the qualitative features of damage are unique for different ions. These features must be incorporated into any risk assessment system for radiation health management. HZE induced mutation, cell inactivation and altered organogenesis will be discussed emphasizing studies with the nematode Caenorhabditis elegans and cultured cells. Observations from radiobiology experiments in space will also be reviewed along with plans for future space-based studies. Author

A91-14074*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE HZE RADIATION PROBLEM
WALTER SCHIMMERLING (JPL, Pasadena, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(Contract NIH-CA-23247; DE-AC03-76SF-00098)
(IAF PAPER 90-553) Copyright

Radiation-exposure limits have yet to be established for missions envisioned in the framework of the Space Exploration Initiative. The radiation threat outside the earth's magnetosphere encompasses protons from solar particle events and the highly charged energetic particles constituting galactic cosmic rays; radiation biology entails careful consideration of the extremely nonuniform patterns of such particles' energy deposition. The ability to project such biological consequences of exposure to energetic particles as carcinogenicity currently involves great uncertainties from: (1) different regions of space; (2) the effects of spacecraft structures; and (3) the dose-effect relationships of single traversals of energetic particles. O.C.

A91-14166#
INFLUENCE OF HYPERGRAVITY ON SWIMMING BEHAVIOUR AND MULTIPLICATION IN PARAMECIUM TETRAURELIA
G. RICHOILLEY, G. GASSET, R. ROUSSEILLE, and H. PLANEL (Toulouse III, Universite, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p. refs
(IAF PAPER 90-523)

Hypergravity results in a reduced growth rate in Paramecium tetraurelia. This effect is not due to changes in hydrostatic pressure. On the other hand, the negative geotaxis, demonstrated in previous experiments carried out in centrifuges, was confirmed using a video

camera and a centrifuge microscope. With the same device, it was demonstrated that the swimming velocity decreases when paramecia are exposed to hypergravity. Furthermore, camera video observations confirmed the role of small and short fluctuations in gravity level in centrifugation experiments: indeed, centrifuged paramecia are not sedimented and are exposed to various gravity levels. Author

A91-14167#
STATEX II ON SPACELAB MISSION D-2 - AN OVERVIEW OF THE JOINT PROJECT 'GRAVIPERCEPTION AND NEURONAL PLASTICITY' AND PRELIMINARY PRE-FLIGHT RESULTS
J. NEUBERT, W. BRIEGLEB, A. SCHATZ (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), H. RAHMANN, K. SLENZKA (Stuttgart, Universitaet, Federal Republic of Germany) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 12 p. refs
(IAF PAPER 90-528) Copyright

The effects of near-weightlessness on the behavior, structure, histology and biochemistry of the vestibular gravity receptor system of the clawed toad Xenopus laevis Daudin and the cichlid fish Oreochromis mossambicus are discussed in an attempt to contribute to the understanding of the plasticity of nervous system functions. The STATEX experiment conducted on the Spacelab mission D-2 is reviewed. Procedures demonstrating the functional quality, suitability, and biological compatibility of the hardware and materials used in the tests are presented together with results of ground-based preflight experiments. Quantitative analyses of swimming behavior of hyper-g vs 1 g controls reveal significant and long-lasting changes in velocity, distance covered, swimming/resting time, and spatial distributions. B.P.

A91-14168#
CORRELATION BETWEEN ELECTRIC SKIN RESISTANCE AND PSYCHO-EMOTIONAL STATE IN MONKEYS
H.-U. BALZER, E. WACHTEL, K. HECHT (Berlin, Humboldt-Universitaet, Federal Republic of Germany), and M. A. SHIRVINSKAIA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p.
(IAF PAPER 90-531)

Variable biorhythms and electrical skin resistances of two tranquil Rhesus monkeys were investigated in order to establish the characteristics of involuntary emotional state. Blood pressure, respiration, heart rhythm, and a number of other indicators were measured but the electrical skin activity caused by functional changes in the sweat glands was considered to be of greatest interest. B.P.

A91-14179#
IBIS - A NEW FACILITY FOR GRAVITATIONAL BIOLOGY
J. RAFFIN, L. BRAAK, G. GARGIR (CNES, Toulouse, France), and H. BOZOUKLIAN (CNES, Paris, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p.
(IAF PAPER 90-551) Copyright

This paper describes the design and operations of IBIS, a gravitational biology instrument that is being developed by the Centre National d'Etudes Spatiales for automated cell-biology experiments in space. IBIS includes three independent thermal chambers connected to each other by 'lifts' for the transfer of biological samples: a refrigerator that can be set for 4 or 8 C, an incubator adjustable from 20 to 37 C, and an intermediate zone. The total capacity of IBIS is 256 independent culture mediums, with provision for automatic injection of three different liquid additives to each of the media. IBIS is planned for missions lasting up to 3 weeks. I.S.

A91-14180#
BIOREACTOR EXPERIMENT - A STUDY OF THE ADAPTATION OF FERMENTATION TECHNOLOGY TO MICROGRAVITY ENVIRONMENT
M. PASTOR, G. MONSERRAT (Nuevas Tecnologias del Espacio, S.A., Barcelona, Spain), F. GODIA, C. CASAS, and C. SOLA (Unidad de Ingenieria Bioquimica, Barcelona, Spain) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(IAF PAPER 90-552) Copyright

The technology behind a bioreactor experiment in a microgravity environment is described. Fermenter technology is discussed as well as microorganism choice, nonzero acceleration, and gas exchanges. Consideration is also given to power requirements and thermal control. K.K.

A91-14221
MICROBIAL CONTROL OF SILVER MINERALIZATION AT A SEA-FLOOR HYDROTHERMAL SITE ON THE NORTHERN GORDA RIDGE
ROBERT A. ZIERENBERG (USGS, Menlo Park, CA) and PETER SCHIFFMAN (California, University, Davis) Nature (ISSN 0028-0836), vol. 348, Nov. 8, 1990, p. 155-157. Research supported by the U.S. Navy. refs
Copyright

Some surfaces of the crust of the Sea Cliff hydrothermal field on the northern Gorda Ridge were formerly colonized by bacterial mats, which are locally preserved by replacement and overgrowth of the bacterial filaments by metal sulfide minerals and amorphous silica. The bacterial filaments are selectively replaced by prousite, pearceite, chalcopyrite, and rarely by galena. Observations are reported here which suggest that bacterially mediated processes selectively precipitate silver, arsenic, and copper, and that biological processes may contribute to precious-metal enrichment in some sea-floor hydrothermal base-metal sulfide deposits. C.D.

A91-14274
AEROBIC RESPIRATION IN THE ARCHAEAN?
KENNETH M. TOWE (Smithsonian Institution, Washington, DC) Nature (ISSN 0028-0836), vol. 348, Nov. 1, 1990, p. 54-56. refs
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The earth's atmosphere during the Archaean era is generally thought to have been anoxic. In the absence of aerobic consumption of oxygen produced by photosynthesis in the ocean, the major sink for this oxygen would have been oxidation of dissolved Fe(II). Atmospheric oxygen would also be removed by the oxidation of biogenic methane. But even very low estimates of global primary productivity seem to require the sedimentation of an unrealistically large amount of iron and the oxidation of too much methane if global anoxia was to be maintained. It is suggested here that aerobic respiration must have developed early in the Archaean to prevent a buildup of atmospheric oxygen before the Proterozoic. An atmosphere that contained a low but stable proportion of oxygen is required. Author

A91-15222* Houston Univ., TX.
THE ORIGIN AND EARLY EVOLUTION OF LIFE ON EARTH
J. ORO (Houston, University, TX), STANLEY L. MILLER (California, University, La Jolla), and ANTONIO LAZCANO (Universidad Nacional Autonoma de Mexico, Coyoacan, Mexico) IN: Annual review of earth and planetary sciences. Volume 18. Palo Alto, CA, Annual Reviews, Inc., 1990, p. 317-356. refs
(Contract NGR-44-005-002; NAGW-20)
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Results of the studies that have provided insights into the cosmic and primitive earth environments are reviewed with emphasis on those environments in which life is thought to have originated. The evidence bearing on the antiquity of life on the earth and the prebiotic significance of organic compounds found in interstellar clouds and in primitive solar-system bodies such as comets, dark asteroids, and carbonaceous chondrites are assessed. The environmental models of the Hadean and early Archean earth are discussed, as well as the prebiotic formation of organic monomers and polymers essential to life. The processes that may have led to the appearance in the Archean of the first cells are considered, and possible effects of these processes on

the early steps of biological evolution are analyzed. The significance of these results to the study of the distribution of life in the universe is evaluated. V.T.

A91-16151* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
FRACTAL DIMENSION OF BIOCONVECTION PATTERNS
DAVID A. NOEVER (NASA, Marshall Space Flight Center; Universities Space Research Association, Huntsville, AL) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 59, Oct. 1990, p. 3419-3422. refs
Copyright

Shallow cultures of the motile algal strain, Euglena gracilis, were concentrated to 2 x 10 to the 6th organisms per ml and placed in constant temperature water baths at 24 and 38 C. Bioconvective patterns formed an open two-dimensional structure with random branches, similar to clusters encountered in the diffusion-limited aggregation (DLA) model. When averaged over several example cultures, the pattern was found to have no natural length scale, self-similar branching, and a fractal dimension (d about 1.7). These agree well with the two-dimensional DLA. Author

A91-16817
REGIONAL H2O2 CONCENTRATION IN RAT BRAIN AFTER HYPEROXIC CONVULSIONS
CLAUDE A. PIANTADOSI and LYNN G. TATRO (Duke University, Durham, NC) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Nov. 1990, p. 1761-1766. refs
Copyright

The production of H2O2 in six different anatomical regions of the rat brain was measured before and after convulsions induced by hyperbaric hyperoxia (HBO), using a sensitive polarographic technique. Estimated H2O2 concentrations during HBO showed increases of 2.2-7.3 times normoxic values in cerebellum and posterior subcortex, indicating that H2O2 is an important mediator of selective neuronal vulnerability of the central nervous system to oxygen toxicity. I.S.

N91-13051*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SPACE AND BIOTECHNOLOGY: AN INDUSTRY PROFILE
RICHARD S. JOHNSTON, DAVID J. NORTON, and BALDWIN H. TOM Nov. 1988 93 p
(Contract NCC9-16)
(NASA-CR-187034; NAS 1.26:187034) Avail: NTIS HC/MF A05 CSCL 06/3

The results of a study conducted by the Center for Space and Advanced Technology (CSAT) for NASA-JSC are presented. The objectives were to determine the interests and attitudes of the U.S. biotechnology industry toward space biotechnology and to prepare a concise review of the current activities of the biotechnology industry. In order to accomplish these objectives, two primary actions were taken. First, a questionnaire was designed, reviewed, and distributed to U.S. biotechnology companies. Second, reviews of the various biotechnology fields were prepared in several aspects of the industry. For each review, leading figures in the field were asked to prepare a brief review pointing out key trends and current industry technical problems. The result is a readable narrative of the biotechnology industry which will provide space scientists and engineers valuable clues as to where the space environment can be explored to advance the U.S. biotechnology industry. Author

N91-13052*# Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 28
LYDIA RAZRAN STONE, ed., RONALD TEETER, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, DC.) Washington NASA Nov. 1990 142 p
(Contract NASW-4292)
(NASA-CR-3922(33); NAS 1.26:3922(33)) Avail: NTIS HC/MF A07 CSCL 06/3

This is the twenty-eighth issue of NASA's Space Life Sciences Digest. It contains abstracts of 60 journal papers or book chapters published in Russian and of 3 Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. The abstracts in this issue have been identified as relevant to 20 areas of space biology and medicine. These areas include: adaptation, aviation medicine, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, equipment and instrumentation, hematology, human performance, immunology, life support systems, mathematical modeling, musculoskeletal system, neurophysiology, personnel selection, psychology, radiobiology, reproductive system, and space medicine. Author

52

AEROSPACE MEDICINE

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

A91-13024
BODY WATER AND ELECTROLYTE RESPONSES TO ACETAZOLAMIDE IN HUMANS
W. F. BRECHUE, J. M. STAGER, and H. C. LUKASKI (Indiana University, Bloomington; USDA, Human Nutrition Research Center, Grand Forks, ND) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Oct. 1990, p. 1397-1401. Research supported by Indiana University. refs
Copyright

Nine healthy males are evaluated for hydration status after clinically prescribed doses of acetazolamide (ACZ) in order to establish the influence of ACZ treatment on body water. It is observed that ACZ leads to a 1.7-liter (3.4 percent) reduction in total body water and a 3.3-liter (21 percent) decrease in extracellular water. The loss of extracellular water is partitioned into a 2.98-liter (27 percent) loss of interstitial water and a 0.32-liter (8.8 percent) loss of plasma water. It is concluded that acute clinical doses of ACZ reduce body fluid compartments, leading to a moderate isosmotic hypovolemia with an intracellular volume expansion as well as metabolic acidosis. V.T.

A91-13025
ACETAZOLAMIDE ALTERS TEMPERATURE REGULATION DURING SUBMAXIMAL EXERCISE
W. F. BRECHUE and J. M. STAGER (Indiana University, Bloomington) Journal of Applied Physiology (ISSN 0161-7567), vol. 69, Oct. 1990, p. 1402-1407. Research supported by Indiana University. refs
Copyright

The purpose of the study is to quantify the effects of carbonic anhydrase inhibition by acetazolamide (ACZ) on appropriate measures of cardiovascular and thermoregulatory function during submaximal exercise. ACZ results in a moderate hypohydration before exercise, evidenced by a 9.1-percent decrease in plasma volume compared with placebo. Plasma volume decreases during the first 15 min of exercise with placebo and ACZ. Whole-body sweat loss is reduced 23 percent, while heat storage is increased 55 percent. A significant inverse relationship between heart rate and stroke volume is observed. It is concluded that previously reported decreases in the ability to sustain submaximal exercise with ACZ may be related to hypohydration-induced impairment of the cardiovascular and thermoregulatory systems. V.T.

A91-13426* Kansas State Univ., Manhattan.
PERFORMANCE OF A BLOOD CHEMISTRY ANALYZER DURING PARABOLIC FLIGHT
BRIAN S. SPOONER, DALE E. CLAASSEN, and JAMES A. GUIKEMA (Kansas State University, Manhattan) Space Technology - Industrial and Commercial Applications (ISSN

0892-9270), vol. 10, no. 3, 1990, p. 135-138. refs
(Contract NAGW-1197)
Copyright

The performance of the Vision System Blood Analyzer during parabolic flight on a KC-135 aircraft (NASA 930) has been tested. This fully automated instrument performed flawlessly in these trials, demonstrating its potential for efficient, reliable use in a microgravity environment. In addition to instrument capability, it is demonstrated that investigators could readily fill specially modified test packs with fluid during zero gravity, and that filled test packs could be easily loaded into VISION during an episode of microgravity.
Author

A91-14063#
ASSESSMENT OF THE CARDIAC AND PERIPHERAL HAEMODYNAMICS DURING THE 25 DAYS FRENCH-SOVIET SPACEFLIGHT

PH. ARBEILLE, J. M. POTTIER, F. PATAT, L. POURCELOT (Institut National de la Sante et de la Recherche Medicale; Centre Hospitalier Universitaire Bretonneau, Tours, France), G. FOMINA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 7 p. Research supported by CNES. refs
(IAF PAPER 90-515) Copyright

The cardiovascular function of the astronaut during a one-month spaceflight is assessed, and new vascular areas such as the renal and intracerebral circulation or the venous system are investigated. An ultrasound Doppler device utilizing two duplex modes is employed in the experiment. Hemodynamic parameters such as the left ventricle function, pulmonary circulation, and mitral flow are considered along with vascular parameters: venous return, vascular resistance, blood flow, and peripheral vein dimension and compliance. It is observed that the reduction of the cardiac chamber volume, the increase of the heart rate, and the acceleration of the venous return velocity suggest a hypovolemia which triggers a decrease in the vascular resistance over the main vascular areas. It is pointed out that the venous system is seriously disturbed since the beginning of the flight and does not recover during the flight. V.T.

A91-14064#
THE PECULIARITIES OF DRUG SUSCEPTIBILITY CHANGES IN SPACE CREW MEMBERS MICROFLORA

V. K. IL'IN, A. N. VIKTOROV, and M. P. BRAGINA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p. refs
(IAF PAPER 90-517) Copyright

The paper deals with the problem of space crew members normal intestinal flora drug resistance, which change during space missions, and also deals with changes taking place in microflora of healthy volunteers during several simulation studies. For this purpose 3140 Escherichia coli strains isolated from both cosmonauts and volunteers were tested for susceptibility to 11 antibiotics of various biochemical groups. The mechanism of drug susceptibility has also been investigated. Special drug susceptibility changes, common for both space flights and simulation studies, were found. These are: an increase of resistant strain number taking place during the first 7-10 days of isolation; the restoration of drug susceptibility taking place after 20-22 days of isolation and later; and the accumulation of drug resistance determinants by a certain number of potentially pathogenic strains. Author

A91-14071#
RADIATION SHIELDING ESTIMATION FOR MANNED SPACE FLIGHT TO THE MARS

V. E. DUDKIN, E. E. KOVALEV, A. V. KOLOMENSKII, V. A. SAKOVICH (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), V. F. SEMENOV (AN SSSR, Institut Vysokikh Temperatur, Moscow, USSR) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p. refs
(IAF PAPER 90-544) Copyright

The problem of shielding the crew from radiation during Mars missions is studied. Radiation hazards caused by Galactic cosmic rays (GCR) and solar cosmic rays (SCR) are considered, and it is noted that a radiation-proof shelter can reduce the hazards associated with SCR, while the shielding from multicharged GCR ions may be required for a habitation section of the spacecraft. The pulse operation of a nuclear rocket engine may also require some additional shielding of the crew and liquid-hydrogen tanks against reactor radiation. It is pointed out that any long-term residence within the earth radiation belt can be avoided by using certain combinations of space flight conditions, while Martian mission conditions may be attained by solving the problem of optimal distribution of the mass components for shadow shielding of the reactor and for shielding of the radiation-proof shelter and habitation section. The lowest estimate of the spacecraft mass including the radiation-shielding mass is found to be 500-550 tons. V.T.

A91-14162*# National Aeronautics and Space Administration, Washington, DC.
CARDIOVASCULAR FUNCTION IN SPACE FLIGHT

A. E. NICOGOSSIAN, J. B. CHARLES, M. W. BUNGO, and C. S. LEACH-HUNTOON (NASA, Washington, DC) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 7 p. refs
(IAF PAPER 90-511) Copyright

Postflight orthostatic intolerance and cardiac hemodynamics associated with manned space flight have been investigated on seven STS missions. Orthostatic heart rates appear to be influenced by the mission duration. The rates increase during the first 7-10 days of flight and recover partially after that. Fluid loading is used as a countermeasure to the postflight orthostatic intolerance. The carotid baroreceptor function shows only slight responsiveness to orthostatic stimulation. Plots of the baroreceptor function are presented. It is concluded that an early adaptation to the space flight conditions involves a fluid shift and that the subsequent alterations in the neutral controlling mechanisms contribute to the orthoststic intolerance. B.P.

A91-14163*# Texas Univ., Houston.
PREVENTION OF SPACE FLIGHT INDUCED SOFT TISSUE CALCIFICATION AND DISUSE OSTEOPOROSIS

VICTOR S. SCHNEIDER (Texas, University, Houston), ADRIAN LEBLANC (Baylor College of Medicine, Houston, TX), and CAROLYN L. HUNTOON (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 3 p. refs
(IAF PAPER 90-512) Copyright

Medical complications such as renal stone formation, increased uric acid output, and disuse osteoporosis are discussed. A series of experiments was conducted in order to study and eventually reduce these flight hazards. Attempts to prevent the negative calcium balance and loss of calcaneal density during prolonged bed rest had only a limited success. Of the five biochemical regiments tested, only diphosphonate applied in a high dose had a positive effect in elliminating mineral losses. It is found that clodronate can prevent disuse osteoporosis and that fluoride can enhance bone formation. It is concluded that exercises, combined with pharmaceutical agents, are beneficial during long-duration space missions. B.P.

A91-14164#
FIRST RESULTS OF PO2 EXAMINATIONS IN THE CAPILLARY BLOOD OF COSMONAUTS DURING A LONG-TERM SPACE FLIGHT IN THE SPACE STATION 'MIR' (EXPERIMENT 'OXITEST')

H. HAASE (Institute of Aviation Medicine, Koenigsbrueck, Federal Republic of Germany), V. M. BARANOV, N. M. ASIAMOLOVA, V. V. POLIAKOV, IU. G. AVAKIAN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical

Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 5 p. refs
(IAF PAPER 90-518) Copyright

The pO2 in arterialized capillary blood has been determined with a measuring device especially developed for the use in space. A clear drop in the pO2 during the flight by 12 to 30 percent compared with the preflight values is found. The decrease in pO2 is attributed to a disturbance of the ventilation/perfusion ratio as a consequence of the hypervolaemia in the thoracic region conditioned by weightlessness. The decreased pO2 values found could point to the fact that weightlessness leads to a minor to moderate but clinically not relevant impaired diffusion. Author

A91-14165#
TEMPORARY RESULTS OF THE EXAMINATION OF THE AUDITION OF COSMONAUTS DURING A LONG-TERM FLIGHT IN THE SPACE STATION 'MIR' WITH THE AUDIOMETER 'ELBE-2' (EXPERIMENT 'AUDIO-2')
W. PROEHL, J. BIRKE (Institute of Aviation Medicine, Koenigsbrueck, Federal Republic of Germany), and M. V. NEFEDOVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p.
(IAF PAPER 90-519) Copyright

In-flight hearing experiments performed on six Mir cosmonauts are presented. Air and bone conduction thresholds for clear sounds are found to be between 0.25 and 6.0 kHz; frequency, amplitude modulation, and discomfort thresholds are between 0.5 and 6.0 kHz. A comparison between the pre-flight and post-flight hearing data is drawn. Data from cosmonauts using noise protection equipment during 150-241 flight days show similarities. Differences are observed in the data from cosmonauts with 366 flight days and, in one case, the hearing did not return to normal even 71 days after the landing. B.P.

A91-14170#
EFFECT OF MICROGRAVITY ON SEVERAL VISUAL FUNCTIONS DURING STS SHUTTLE MISSIONS
MELVIN R. O'NEAL, H. LEE TASK, and LOUIS V. GENCO (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 9 p. refs
(IAF PAPER 90-536)

Changes in the acuity of astronaut vision during flight are discussed. Parameters such as critical flicker vision, stereopsis to 10 seconds-of-arc, visual acuity in small steps to 20/7.7, cyclophoria, lateral and vertical phoria, and retinal rivalry were tested using a visual function tester. Twenty-three STS astronauts participated in the experiments and their vision was assessed twice before launch and after landing, and 3-4 times while on-orbit and at landing. No significant differences during space flight were observed for any of the visual parameters tested. In some cases, slight changes in acuity and stereopsis were observed with a subsequent return to normal vision after the flight. B.P.

A91-14176
DOSIMETRIC COMPLEX FOR LONG-TIME MANNED SPACE FLIGHTS
IU. AKATOV, E. E. KOVALEV, V. A. SAKOVICH (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), S. DEME, I. FEHER (Magyar Tudomanyos Akademia, Kozponti Fizikai Kutato Intezet, Budapest, Hungary) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p. refs
(IAF PAPER 90-546)

The design of a spacecraft radiation safety system for long-term manned space flights is discussed. Consideration is given to the methods for calculating the radiation risk when taking into account the prescribed space flight programs and strict schedules, as well as the probability of deviations. The onboard radiation monitoring systems are described with special attention given to sensors used for continuous monitoring of the absorbed dose. I.S.

A91-14178#
A DEVICE FOR MEASURING THE RESPIRATORY IMPEDANCE UNDER SPACE CONDITIONS
H.-GEORG NACKE (Dresden Institute of Transport and Communication, Federal Republic of Germany), HANS HAASE, JOACHIM KOENIG (Institute of Aviation Medicine, Koenigsbrueck, Federal Republic of Germany), ALEKSANDR I. D'IACHENKO, and V. M. BARANOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 9 p. refs
(IAF PAPER 90-549) Copyright

This paper describes some aspects of the theoretical fundamentals and the technical and algorithmic solutions deduced from them for the determination of the oscillatory airway resistance, which served as the basis for the construction of a device designed for the measurement of physiological lung parameters. Some experimental results that were obtained with this device are interpreted and ways for an improvement of the procedure, which at the moment has no alternatives under space conditions, are shown. Author

A91-16294
RENAL EXCRETION OF WATER IN MEN UNDER HYPOKINESIA AND PHYSICAL EXERCISE WITH FLUID AND SALT SUPPLEMENTATION
YAN G. ZORBAS, YOURI F. FEDERENKO, and MITSUI N. TOGAWA (Medical Engineering Institute, Tokyo, Japan) Acta Astronautica (ISSN 0094-5765), vol. 21, Aug. 1990, p. 599-605. refs
Copyright

Studies were performed with the use of fluid and NaCl supplements on 12 highly trained physically healthy male volunteers aged 19-24 years under 364 days of hypokinesis (HK) and a set of intensive physical exercise (PE). The first group of subjects were submitted to HK and took daily fluid and salt supplements in very small doses, and the second group was subjected to intensive PE and fluid-salt supplements. For the simulation of the HK effect, both groups of subjects were kept under an average of 4000 steps/day. During the pre-HK period of 60 days and under the HK period of 364 days, water consumed and eliminated in urine by the men, water content in blood, plasma volume, rate of glomerular filtration, renal blood flow, osmotic concentration of urine and blood were measured. Under HK, the rate of renal excretion of water increased considerably in both groups. The additional fluid and salt intake failed to normalize water balance adequately under HK and PE. It was concluded that negative water balance evidently resulted not from shortage of water in the diet but from the inability of the body to retain optimum amounts of fluid under HK and a set of intensive PEs. Author

A91-16723#
THE EFFECTS OF SIMULATOR VISUAL-MOTION ASYNCHRONY ON SIMULATOR INDUCED SICKNESS
MICHAEL E. MCCAULEY, LAWRENCE J. HETTINGER, THOMAS J. SHARKEY (Monterey Technologies, Inc., Carmel, CA), and JOHN B. SINACORI (John B. Sinacori Associates, Pebble Beach, CA) AIAA, Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990. 9 p. refs
(AIAA PAPER 90-3172) Copyright

The relationship between visually implied and actually accomplished motions was investigated using the NASA Vertical Motion Simulator in four consecutive 10-min segments of increasing maneuverability under one of four motion conditions. Simulator sickness, found in all tests, increases with the exposure time and maneuvering level. The study is intended to develop criteria for the phenomenon and determine whether the conflict between the visually implied motion and the acceleration imparted by the actual motion is a factor contributing to the sickness. B.P.

A91-16749
SPATIAL DISORIENTATION IN THE F-16
GEOFFREY W. MCCARTHY (USAF, Washington, DC; RAF,

Institute of Aviation Medicine, Farnborough, England) Aeromedical and Training Digest (ISSN 0001-9275), vol. 4, July 1990, 3 p.
Copyright

A review is presented of aeromedical problems involving the F-16 with particular regard to spatial disorientation (SDO). In the first ten years of F-16 operation SDO has been responsible for 58 percent of operator-related incidents with an 83 percent fatality rate (second only to G-induced loss of consciousness mishaps). Some of the major factors which make spatial disorientation more likely to occur include the single bubble canopy that removes the ambient visual orientation cues provided by the canopy bow of older aircraft, intense reflection of cockpit lights that are distracting to the pilot, and the small cockpit size that has necessitated a drastic reduction in instrument size resulting in suboptimal line of sight for a rapid recovery from disorientation. The HUD and FBW systems are also described as SDO problem areas. R.E.P.

A91-16750
DEFINITION OF SPATIAL DISORIENTATION
JOHN GREENE (USAF, Tactical Air Command, Langley AFB, VA) Aeromedical and Training Digest (ISSN 0001-9275), vol. 4, Oct. 1990, 2 p.
Copyright

As currently defined, spatial disorientation may be divided into three categories: (1) where the aircrew member is not aware that his percept of orientation is wrong, (2) where the aircrewman recognizes that he is disoriented, and (3) where the aircrewman is incapacitated. These three categories are then further amplified, as is the phenomenon of temporal distortion which may occur during the performance of complex skills. Conscious visual crosscheck of a valid visual orientation reference may be delayed, allowing the subconscious to fly the aircraft to the point where crosscheck delay is longer than the time to impact of the aircraft. It should be recognized that spatial disorientation is a principal part of the loss of the situational awareness problem and should not be defined as a sole entity. R.E.P.

N91-12188# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.
ASSESSMENT OF BODY WEIGHT STANDARDS IN MALE AND FEMALE ARMY RECRUITS Final Technical Report, Jun. 1988 - Dec. 1989
KARL E. FRIEDL, JAMES A. VOGEL, MATTHEW W. BOVEE, and BRUCE H. JONES 29 Dec. 1989 95 p
(Contract DA PROJ. 3E1-62787-A-879)
(AD-A224586; ARIEM-T15-90) Avail: NTIS HC/MF A05 CSCL 06/4

Army enlisted candidates are screened for obesity with height-weight tables (AR 40-501) which exclude few young males but approximately one third of young females in the U.S. population. Another regulation (AR 600-9) sets standards for retention in the Army on the basis of body fat estimated from circumferences. The suitability of accession weight standards with respect to the retention standards was examined by studying the effect of excess fatness on attrition from active duty, physical performance, and ability to achieve fat standards after basic training. GRA

N91-12189# Kentucky Univ., Lexington.
A NORMATIVE DATA STUDY OF ISOMETRIC NECK STRENGTH IN HEALTHY, ADULT MALES, AGES 18-35 M.S. Thesis
JULIE RIEDEL KELLER 1990 105 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224642; AFIT/CI/CIA-90-063) Avail: NTIS HC/MF A06 CSCL 06/4

Isometric neck muscle contraction forces generated during attempted neck flexion, extension, and side bending by sixty subjects were measured using a load cell in order to establish normal ranges for cervical muscle strength. Contraction forces during three trials were collected and measured using ASYST 2.01. Time averaged forces and instantaneous peak forces generated were compared and no significant differences were evident. Measured mean extension forces (236 N) exceeded mean flexion forces (202 N) and mean side bending forces (155 N). Anthropometric measurements correlated poorly with measured cervical forces and are not recommended as cervical strength predictors. Correlations between dominant grip strength and neck strength were sought but no relationship was apparent. Force variability between trials was evaluated with analysis of variance testing, with significance set at p is less than 0.05. Increased forces were generated by successive contractions. Comparisons between right and left lateral neck strength indicated no statistically significant functional asymmetry between the two sides. Six subjects (10 percent) were randomly selected to return for repeat testing to evaluate test-retest reliability using paired t-tests, and no consistent differences between tests were evident. GRA

N91-12190# Florida State Univ., Tallahassee. Dept. of Psychology.
DETECTING TARGET WORDS WHILE MONITORING MULTIPLE AUDITORY INPUTS M.S. Thesis
JOHN M. BARKER, JR. 1990 38 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224687; AFIT/CI/CIA-90-060) Avail: NTIS HC/MF A03 CSCL 06/4

How can humans best detect an auditory input while monitoring several inputs simultaneously is examined. Two separate experiments were conducted, using a divided attention paradigm, to determine what factors influence target word detectability. Results from both experiments show an advantage in target detection if a person listens to one input in one ear and the other in the other ear (stereo) versus listening to both inputs in both ears (mono). Target detection was unaffected by variations in presentation rate in the range of 0.5 to 1.5 seconds. In the second experiment number of voices was examined as a factor. When both inputs were presented to each ear (mono) there was a clear advantage when listening to inputs that were recorded using two different voices (female and male) versus using only one voice (male only). However, the addition of a second voice did not improve target detection in the stereo condition. This latter finding may represent a limit on the effects of channel separation in target detection situations. Both a recency and primacy effect in terms of target detection as a function of the targets serial position in the list was found in both experiments. Results of these experiments have direct implications for practical applications, such as communication systems used by airline pilots. GRA

N91-12191# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
AN EXTENSION OF THE KREMERS/VAN NORREN MODEL FOR RETINAL LIGHT DAMAGE AND CONSEQUENCES THEREOF FOR OCCUPATIONAL SAFETY Final Report
J. J. VOS 15 Mar. 1990 33 p
(AD-A224879; IZF-1990-A-16; TDCK-90-0031) Avail: NTIS HC/MF A03 CSCL 06/4

The Kremers/Van Norren model gives a comprehensive across species description of retinal light damage threshold as a function of exposure time. It is based upon the assumptions that absorption in pigments in retina and pigment epithelium produces a toxic agent; that at sub-bleaching light levels the main mediating pigment is rhodopsin; and that at supra-bleaching level other pigments, possibly rhodopsin bleach products, take over. In the first part, the validity is verified of a few silent assumptions in the Kremers/Van Norren model: the neglection of the dynamic nature of the bleach process; the assumption that it is the maximum concentration of the toxic agent that determines the degree of damage; and the assumption that there is no cumulative effect of residual damage. The first assumption proved to be entirely justified. The second one not, but the mathematics of the original Kremers/Van Norren description remain valid when their 3.5 x 10(5) time constant is applied to the repair process, rather than to the toxic agent removal. As to the last assumption, the consequences of a cumulative residual damage mechanism are quantified. In the second part, consequences were drawn for practice. This is done in two ways. In the first place the results of the model computations were converted to convential Threshold

Limit Values (TLVs) to make them comparable to current safety standards. It is shown that, on the basis of the model interpretation, these need considerable revision in the long term exposure domain. GRA

N91-12192# Dayton Univ., OH. Research Inst.
EFFICIENT IMAGE GENERATION USING LOCALIZED FREQUENCY COMPONENTS MATCHED TO HUMAN VISION Final Technical Report, Oct. 1987 - Feb. 1990
GEORGE A. GERI, YEHOSHUA Y. ZEEVI, and MOSHE PORAT (Technion - Israel Inst. of Tech., Haifa.) Jul. 1990 66 p
(Contract F33615-87-C-0012; AF PROJ. 1121; AF PROJ. 2313)
(AD-A224903; AFHRL-TR-90-25) Avail: NTIS HC/MF A04 CSCL 12/5

Following a brief tutorial in the general area of image analysis, a formalism is presented for using the generalized Gabor approach to image representation in the combined frequency-position space. This approach uses elementary functions to which the human visual system is particularly sensitive and which are efficient for the analysis and synthesis of visual imagery. Among the topics covered are the complementarity of position and spatial frequency in the Gabor scheme, and the use of an auxiliary function to render the nonorthogonal Gabor elementary functions transformable. The formalism is in particular compatible with the implementation of a variable resolution system wherein image information is nonuniformity distributed across the visual field in accordance with the human visual system's ability to process it. A possible hardware implementation of such a system is described and some potential problems associated with its development are discussed.
Author (GRA)

N91-12193# Illinois Univ., Urbana-Champaign. Aviation Research Lab.
THE EFFECTS OF ATROPINE SULFATE ON AVIATOR PERFORMANCE Final Report, 15 May 1983 - 14 Sep. 1984
HENRY L. TAYLOR, JOHN A. DELLINGER, BRUCE C. RICHARDSON, MARTHA H. WELLER, STEPHEN W. PORGES, CHRISTOPHER D. WICKENS, JAMES E. LEGRAND, and JOHN M. DAVIS Sep. 1989 78 p
(Contract DAMD17-83-C-3150; DA PROJ. 3M4-63764-D-995)
(AD-A224916; ARL-TR-85-1; USAARL-CR-89-9) Avail: NTIS HC/MF A05 CSCL 06/5

The purpose of the present study was to determine the effect of atropine sulfate on pilot performance, as measured in a flight simulator, and to investigate physiological correlates of this effect. The six dependent measures of flying the simulator using standard instrument procedures indicated the significant effects of atropine was found between the 0.5 and the 4.0 mg levels atropine. The most significant effect was to the 4.0 mg level. For the Sternberg secondary task, reaction time and accuracy showed no atropine effects. Mean heart period (MHP), heart period variance (HPV), showed the effects of atropine sulfate and the time course of the effect. It was concluded that the 4.0 mg level of atropine produced significant performance decrements and increased the risk of error when performing complex pilot tasks. The performance effects were found to lag behind the physiological effects. GRA

N91-12194# Northwestern Univ., Evanston, IL.
THE 1988 ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 1: STATISTICAL TECHNIQUES, LANDMARK, AND MEASUREMENT DEFINITIONS Final Report, 1 Apr. 1989 - 31 Mar. 1990
JAMES CHEVERUD, CLAIRE C. GORDON, ROBERT A. WALKER (Army Natick Research and Development Command, MA.), CASHELL JACQUISH, LUCI KOHN, ALLEN MOORE, and NYUTA YAMASHITA May 1990 76 p
(Contract DAAK60-89-C-1006)
(AD-A224986; NATICK-TR-90/032-PT-1) Avail: NTIS HC/MF A05 CSCL 05/9

This five-part series of reports tabulates the statistical relationships among anthropometric measurements so that designers of Army materiel systems will be able to utilize the data in improving the man-materiel interface. The kinds of statistical relationships tabulated include simple correlations, partial correlations, bivariate regressions and multiple regressions. The simple correlations, partial correlations, and bivariate regressions are among all pairs of characters. Four sets of partial correlations are included, partialling out: stature only; weight only; stature and weight simultaneously; and stature, weight, and age simultaneously. Standard multiple regressions include specific anthropometric dimensions regressed on standard pairs of measurements. Stepwise multiple regressions were also calculated for each anthropometric dimension using the first five independent variables selected in the stepwise procedure. All analyses were performed separately for males and females and are reported separately in the tables. GRA

N91-12195# Ohio Wesleyan Univ., Delaware. Vision Lab.
ANALYSIS OF RETINAL FUNCTION FOLLOWING LASER IRRADIATION Midterm Technical Report, 30 Oct. 1987 - 29 Oct. 1989
DAVID O. ROBBINS May 1990 25 p
(Contract DAMD17-88-C-8032; DA PROJ. 3E1-62787-A-878)
(AD-A225021) Avail: NTIS HC/MF A03 CSCL 06/5

Exposure of the foveal to a single or multiple pulses of coherent light produce both transient and permanent changes in the eye's ability to resolve fine spatial detail. The immediate effects are often large, reflecting a total loss of foveal functioning although, depending upon exposure conditions, are reversible. Permanent functional changes in achromatic and chromatic acuity can occur in the absence of gross morphological damage and at power densities below the ED50 level provided the area of involvement is large. At power densities above the ED50 level, little if any permanent and consistent deficits in visual performance are noted if the damage is restricted to relatively isolated areas of either the fovea or parafovea. GRA

N91-12196# Anthropology Research Project, Yellow Springs, OH.
THE 1988 ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: METHODS AND SUMMARY STATISTICS Final Report, 1 Oct. 1988 - 24 Mar. 1989
CLAIRE C. GORDON, THOMAS CHURCHILL, CHARLES E. CLAUSER, BRUCE BRADTMILLER, JOHN T. MCCONVILLE, ILSE TEBBETTS, and ROBERT A. WALKER (Army Natick Labs., MA.) Sep. 1989 651 p
(Contract DAAK60-86-C-0128)
(AD-A225094; NATICK-TR-89/044) Avail: NTIS HC/MF A99 CSCL 05/9

Results of the 1987 to 1988 anthropometric survey of Army personnel are presented in this report in the form of summary statistics, percentile data and frequency distribution. These anthropometric data are presented for a subset of personnel (1774 men and 2208 women) sampled to match the proportions of age categories and racial/ethnic groups found in the active duty Army of June 1988. Dimensions given in this report include 132 standard measurements made in the course of the survey, 60 derived dimensions calculated largely by adding and subtracting standard measurement data, and 48 head and face dimensions reported in traditional linear terms but collected by means of an automated headboard designed to obtain three-dimensional data. Measurement descriptions, visual indices, and a glossary of terms are included to help identify and locate dimensions. Descriptions of the procedures and techniques used in this survey are also provided. These include explanations of the complex sampling plan, computer editing procedures, and strategies for minimizing observer error. Tabular material in appendices are designed to help users understand various practical applications of the dimensional data, and to identify comparable data obtained in previous anthropometric surveys. GRA

N91-12197# Oregon Univ., Eugene. Dept. of Computer Science.
STEREOPSIS AND THE COMBINATION OF SURFACE CUES Final Report

KENT A. STEVENS and JACOB BECK 10 Jul. 1990 73 p
(Contract N00014-87-K-0321)
(AD-A225109) Avail: NTIS HC/MF A04 CSCL 06/4

This report describes research regarding the integration of spatial information. Part 1 (Stevens) reports work that addresses questions of integration, including the form of the spatial information provided by human stereopsis towards the perception of visual surfaces and the strategies by which this information is reconciled with monocular 3D information. Part 2 (Beck) concerns how surface orientation and distance are perceived in wire-frame figures that are projected orthographically. GRA

N91-12198# Texas A&M Univ., College Station. Hyperbaric Lab.

THE EFFECT OF HEATING ON TENDON AND JOINT BLOOD FLOW Final Report, Aug. 1987 - Jan. 1989

WILLIAM P. FIFE Jun. 1990 28 p
(Contract F33615-87-C-0604)
(AD-A225233; USAFSAM-TR-89-13) Avail: NTIS HC/MF A03 CSCL 06/10

Current decompression sickness prevention techniques which offer only limited or intermittent perfusion of tight connective tissues is the suspected reason for long nitrogen washout times. If this is the case, whether heat applied to bends-susceptible joints may increase perfusion and decrease washout times is investigated. A laser Doppler probe was used to evaluate perfusion in Achilles tendons of 20 pigs, 5 dogs, and 4 goats. Baseline measurements were taken with motionless animals. Heating was then applied and resulting measurements were compared. Earlier observations that tendon blood flow shut down for extended period of time was not confirmed. In this study, there was a constant, but low perfusion of the tendons and joint capsules in all three species tested and perfusion appeared to be uniform throughout each tendon or capsule. Local heating elevated the perfusion by as much as 300 percent in some animals, although the elevation was not consistent or statistically significant since the laser beam observed a volume of approximately 1 cu mm, and at no time was there zero flow. It appears that even if there was local shutdown of perfusion in a small area adjacent to the one being observed, the perfusion in adjacent areas (within 1 mm) is sufficient to prevent supersaturation with inert gas and hence the formation of bubbles in these tissues. GRA

N91-12568# Wichita State Univ., KS. Dept. of Mechanical Engineering.

DYNAMIC BEHAVIOR OF THE HUMAN BODY SUBJECTED TO IMPACT CONDITIONS WITH AND WITHOUT RESTRAINT

HAMID LANKARANI, DEREN MA, and GAYLE ERMER *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems p 108-131 May 1990
Avail: NTIS HC/MF A17

A simple multiple-segment model of the human body is developed in order to examine its dynamic response under the action of external forcing conditions. The system is modeled as a collection of rigid elements interconnected by an array of kinematic joints constraining the relative motion of the elements. These elements include upper body combined with head and neck, lower legs, and thighs. Nonlinear rotational springs are incorporated at the joints accounting for the anatomical characteristics and limits. The constructed model is used to simulate the post-crash behavior of an aircraft pilot or passenger during surges such as frontal/side collisions and crashes in the vertical plane. A mathematical representation of the seat and interaction of the passenger with the seat cushion and back is developed. Restraints representing the seatbelts are also introduced in the model in a few different configurations. The complete model is then subjected to various pulse accelerations or decelerations in different directions. To perform a dynamic analysis, a three-dimensional code is developed that generates and numerically solves the governing differential equations of motion in a systematic fashion. This feature of generality allows future additions to the present simple model or construction of more advanced models in a convenient way. This computerized model and the results of the simulations provide a base for predicting the motion behavior of the human body parts during crashes, understanding the effects of various types of seats and seatbelts on passenger safety, and design of mechanisms for crash protection and cockpit/cabin interior elements. Author

N91-13053# Research Triangle Inst., Research Triangle Park, NC.

MEASUREMENTS OF EXHALED BREATH USING A NEW PORTABLE SAMPLING METHOD

E. D. PELLIZZARI, K. W. THOMAS, J. H. RAYMER, D. J. SMITH, and S. D. COOPER Jul. 1990 313 p Sponsored by EPA, Research Triangle Park, NC
(Contract EPA-68-02-4544)
(PB90-250135; EPA/600/3-90/049) Avail: NTIS HC/MF A14 CSCL 06/16

Breath measurements offer the potential for a direct and noninvasive evaluation of human exposure to volatile organic compounds (VOCs) in the environments in which people live and work. The research study was conducted to further develop the potential of this exposure assessment methodology. A new alveolar breath measurement technique was developed and tested. Air samples were collected in 32 microenvironments and above 6 consumer products to determine a few potential sources of human exposure to selected VOCs. Elimination half-lives were estimated using a mono- and biexponential model. The alveolar breath collection and analysis methodology proved to be very useful for collecting many samples in short time intervals and this capability was very important for accurately describing the initial phase of the decay curves. Analysis of microenvironment samples from homes, businesses, workplaces, vehicles, etc., revealed a wide range of potential sources of human exposures to VOCs at concentrations from 1 to 16,000 micro-g/cu m. GRA

N91-13054# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

INFLUENCE OF COLD EXPOSURE ON VENTILATION, RESPIRATORY HEAT LOSS, AND PULMONARY DEPOSITION/CLEARANCE Ph.D. Thesis

DONALD A. DIESEL Jun. 1990 170 p
(AD-A224680; AFIT/CI/CIA-90-021D) Avail: NTIS HC/MF A08 CSCL 06/3

Possible thermoregulatory benefits of cold-induced changes in breathing pattern (hypoventilation) and the mechanism(s) by which cold stimulates a change in breathing pattern were investigated in male Holstein calves 1 to 3 months old. Effects of ambient temperatures (Ta) between 4 and 18 C on ventilatory parameters and respiratory heat loss were determined in 4 calves. As Ta decreased, respiratory frequency decreased 29 percent while tidal volume increased 35 percent. Total ventilation (VE) did not change significantly, but the ventilatory equivalent for O2 decreased with decreasing Ta. Calves were capable of conserving respiratory heat during cold exposure by decreasing expired air temperature and by decreasing dead space ventilation while increasing O2 extraction. Hypoventilation is suggested as a mode of heat conservation in cold environments in animals which use panting as a means of increasing evaporative heat loss. The effect of cold-induced hypoventilation on pulmonary particle deposition was investigated in 10 calves. Deposition of nasally-instilled fluorescent Pasteurella haemolytica was significantly higher for cold-exposed calves. It is speculated that the cold-induced respiratory pattern change was responsible. Nasal mucus velocity (NMV) was measured in four unanesthetized calves at Ta = 2 to 4 C and Ta = 16 to 18 C, using a radiographic tracking technique. NMV was 24 percent lower during cold exposure. It is possible that cold-exposure decreases tracheal mucociliary clearance rate. GRA

N91-13055# Northwestern Univ., Evanston, IL.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 2: SIMPLE AND PARTIAL CORRELATION TABLES-MALE Final Report, 1 Apr. 1989 - 31 Mar. 1990

JAMES CHEVERUD, CLAIRE C. GORDON, ROBERT A. WALKER,

CASHELL JACQUISH, and LUCI KOHN May 1990 268 p
(Contract DAAK60-89-C-1006)
(AD-A224987; NATICK-TR-90/033) Avail: NTIS HC/MF A12
CSCL 05/9

The tables in this volume include the simple and partial correlation values among the 180 anthropometric variables analyzed and their correlations with age. The full correlation matrix, with 181 rows and 181 columns (one row and column for each variable) is provided so that all of the correlations for any single variable can be found on contiguous pages. The simple and partial correlation tables are: Male simple correlations; Male partial correlation -- stature, weight, stature and weight, and stature, weight and age. GRA

N91-13056# Northwestern Univ., Evanston, IL.
ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 3: SIMPLE AND PARTIAL CORRELATION TABLES-FEMALE Final Report, 1 Apr. 1989 - 31 Mar. 1990
JAMES CHEVERUD, CLAIRE C. GORDON, ROBERT A. WALKER, CASHELL JACQUISH, and LUCI KOHN May 1990 267 p
(Contract DAAK60-89-C-1006)
(AD-A224988; NATICK-TR-90/034) Avail: NTIS HC/MF A12
CSCL 05/9

Included are the simple and partial correlation tables for females. The partial correlation tables include stature; weight; stature and weight; and stature, weight, and age. B.G.

N91-13057# Northwestern Univ., Evanston, IL.
ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 4: BIVARIATE REGRESSION TABLES Final Report, 1 Apr. 1989 - 31 Mar. 1990
JAMES CHEVERUD, CLAIRE C. GORDON, ROBERT A. WALKER, CASHELL JACQUISH, and LUCI KOHN May 1990 317 p
(Contract DAAK60-89-C-1006)
(AD-A224989; NATICK-TR-90/035) Avail: NTIS HC/MF A14
CSCL 05/9

The tables in this volume contain the simple bivariate regression results, firstly for the males and secondly for the females. A separate listing is provided for each dependent variable. For each dependent variable, all bivariate regressions associated with correlations greater than 0.50 (or coefficients of determination greater than 0.25) are listed. Others, while statistically significant, are considered unreliable for dependent variable value prediction and are therefore not included. All of the regressions reported are statistically significant at the 0.001 level. All variables were analyzed on the millimeter scale, except for weight which is measured to the nearest 0.1 kilogram, so that the constant and standard error of the estimate are given in millimeters. GRA

N91-13058# Northwestern Univ., Evanston, IL.
ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 5: STEPWISE AND STANDARD MULTIPLE REGRESSION TABLES Final Report, 1 Apr. 1989 - 31 Mar. 1990
JAMES CHEVERUD, CLAIRE C. GORDON, ROBERT A. WALKER, CASHELL JACQUISH, and LUCI KOHN May 1990 138 p
(Contract DAAK60-89-C-1006)
(AD-A224990; NATICK-TR-90/036) Avail: NTIS HC/MF A07
CSCL 05/9

Stepwise multiple regression tables are provided separately for males and females. Each table contains a listing for a series of regression equations for each dependent variable. Each dependent variable is first identified by data base number, abbreviated name, and full name. For each listing five columns are presented, each giving the regression constant and coefficient(s) for the best predictive multiple regression including 1, 2, 3, 4, and 5 independent variables, respectively. The last two rows of each listing contain the standard error of the estimate and adjusted coefficient of determination (R-squared) for each of the five sequential models. All models are significantly different from zero at the 0.001 level. GRA

N91-13059# Los Alamos National Lab., NM. Life Sciences Div.
BEHAVIORAL EFFECTS OF 1300 MHZ HIGH-PEAK-POWER MICROWAVE PULSED IRRADIATION Final Report, Jan. 1987 - Mar. 1988
DENNIS L. HJERESEN, ROBERT F. HOEBERLING, JOHN KINROSS-WRIGHT, KATHRYN O. UMBERGER, and B. JON KLAUENBERG Aug. 1990 40 p Prepared in cooperation with School of Aerospace Medicine, Brooks AFB, TX
(AD-A226269; USAFSAM-TR-90-6) Avail: NTIS HC/MF A03
CSCL 05/8

Results of behavioral and physiological studies on the effects of high-peak-power microwaves (HPPM) are reported. Rats were typically irradiated for 10 min using the following HPPM characteristics: 1300 MHz, 10 MW power, 5 and 10 pulses per second (pps), 1.8 kW/sq cm peak-power density with 1, 5, or 10 microseconds pulse widths. Average-power densities were 9, 45 and 90 mW/sq cm at 5 pps and 18, 90 and 180 mW/sq cm at 10 pps; average colonic Specific Absorption Rate (SAR) equals 1.8, 6.5, 13.1 W/kg and 3.6, 13.1, and 26.2 W/kg, respectively. Results indicated the following: (1) Irradiation under 10 microseconds/10 pps protocol (SAR = 26.2 W/kg) reduced locomotor activity; (2) Response rates under a variable-interval (VI) schedule declined after irradiation protocols yielding SARs greater than 13.1 W/kg. Author

N91-13060# California Univ., Irvine. Dept. of Information and Computer Science.
A SHORT REVIEW OF HUMAN MOTOR BEHAVIOR: PHENOMENA, THEORIES, AND SYSTEMS Interim Report, Apr. - Sep. 1989
WAYNE IBA Jul. 1990 24 p
(Contract MDA903-85-C-0324)
(AD-A226271; UCI-ICS-TR-89-34; ARI-RN-90-55) Avail: NTIS HC/MF A03 CSCL 05/8

In this paper we survey three facets of human motor behavior-phenomena, theories, and implementations. We are particularly concerned with motor behavior that exhibits improvements over time and practices; this is referred to as human motor learning. We begin by discussing both performance and learning phenomena that have been observed in laboratory situations. This is followed with a review of three prominent theories of human motor control from the psychological literature. The performance and learning phenomena serve as a foundation on which to compare these theories. Finally, we consider several implemented models of motor learning that have attended to constraints imposed either by the phenomena introduced earlier or by the physiological structure of the human neuromuscular system. From the material surveyed. We conclude that more research on computational model would help answer in human motor behavior. GRA

N91-13061# Southwest Research Inst., San Antonio, TX.
FEASIBILITY OF NMR DETECTION OF DECOMPRESSION BUBBLES Final Report, Oct. 1985 - Nov. 1987
WILLIAM L. ROLLWITZ Jul. 1990 58 p
(Contract F33615-83-D-0602; AF PROJ. 7930)
(AD-A226323; USAFSAM-TP-89-22) Avail: NTIS HC/MF A04
CSCL 06/4

The reported program had four tasks: (1) construct the bubble generator and modify the NMR equipment to contain it; (2) make the NMR measurements and determine T11, T12, and T2 in blood samples both with and without bubbles of oxygen, air, and nitrogen; and (3) obtain a magnetic resonance image (MRI) of the knee and calculate the values of T1 and T2 in the synovial fluid in the knee. All of these tasks were completed. The bubble generator and the equipment modifications were made, tested successfully, and used to make two sets of NMR measurements on 25 samples of blood, in one sample of plasma and in two samples of water. Each sample had one of the following conditions: oxygen tonometer, oxygen bubbles, air tonometer, air bubbles, nitrogen

tonometer, or nitrogen bubbles. In addition, some NMR measurements were made with flowing bubbles. From the NMR data, the relaxation times T2, T11, and T12 were calculated. Two references were found which reported data that showed that the value of T2 varied directly with the percent oxyhemoglobin and this condition was verified by the NMR measurements. From the data, it was concluded that it was feasible to use NMR measurements in blood to indicate the difference between fixed oxygen bubbles, fixed air bubbles, and fixed or flowing nitrogen bubbles in blood. GRA

N91-13062# Midwest Research Inst., Kansas City, MO.
FURTHER STUDIES OF 60 HZ EXPOSURE EFFECTS ON HUMAN FUNCTION
CHARLES GRAHAM and HARVEY D. COHEN Oct. 1990 6 p
(Contract DE-FG01-89CE-34025)
(DE91-000868; DOE/CE-34025/T5) Avail: NTIS HC/MF A02

Public concern has been expressed about possible health risks arising from exposure to the electric and magnetic fields generated power distribution systems. This project is addressing this concern through a laboratory research program designed to evaluate the effects of brief exposure to known field conditions on multiple measures of human function. In previous research, we found that exposure had statistically significant effects on physiological measures of cardiac and brain activity, and on performance measures of reaction time and performance accuracy. Effects were seen more clearly under intermittent exposure conditions, and at certain levels of electric and magnetic field strength. In this continuation effort, we are performing a series of exploratory studies, to be followed by a confirmatory experiment, to determine if the above physiological effects differ as a function of exposure to the electric and magnetic fields separately and combined, time of day, and rate of intermittent exposure. Further studies will explore the mechanisms underlying these effects. The information developed in this project will be of value in risk assessment activities, and in basic research aimed at identifying specific factors involved in the interaction of power line fields with the human system. In this reporting period our goals were to: (1) continue performance of the probe studies; (2) participate in a site visit at MRI; (3) request 1991 research continuation funding; and (4) submit an abstract of project findings for presentation at the 1990 DOE Contractors Review Meeting. DOE

N91-13063* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 342)
Nov. 1990 81 p
(NASA-SP-7011(342); NAS 1.21:7011(342)) Avail: NTIS HC A05; NTIS standing order as PB90-912300, $11.50 domestic, $23.00 foreign CSCL 06/5

This bibliography lists 208 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during October 1990. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N91-13064# Naval Medical Research Inst., Bethesda, MD.
EFFECTS OF HAND AND FOOT HEATING ON DIVER THERMAL BALANCE Technical Report, 1988 - 1989
ROBERT P. WEINBERG and EDWARD D. THALMANN May 1990 50 p
(AD-A226430; NMRI-90-52) Avail: NTIS HC/MF A03 CSCL 23/5

Divers at rest immersed in cold water for long durations wearing passive thermal protection garments are limited by low finger and toe temperatures, which cause pain and numbness before rectal temperatures fall to unsafe levels. It was reasoned that low levels of hand and foot heating might improve diver comfort. Supplemental heating of the hands and feet to maintain finger and toe temperatures between 12 and 18 C (after passive cooling) was employed. A total of 32 divers wearing a dry suit with M-600 Thinsulated undergarments were immersed for periods of up to 8 hours in 3 C water. The divers wore electrical resistance heated gloves and socks over polypropylene liners and under Thinsulated insulation, or warm-water-perfused gloves and socks over polypropylene liners and under foam neoprene insulation. Hands and feet remained dry by communication with the dry suit. Water perfusion rate or electrical power was adjusted to maintain desired digit temperatures. Supplemental heating did not reduce the need for adequate passive whole body thermal insulation for long-duration immersions in cold water. Supplemental heating did not reduce hand and foot discomfort at low energy cost, and reduced the decrement in manual dexterity compared to no heating. The low energy cost of resistance heating makes this feasible for immediate use by the Fleet. GRA

N91-13065# Civil Aeromedical Inst., Oklahoma City, OK.
RIGHT BUNDLE BRANCH BLOCK AS A RISK FACTOR FOR SUBSEQUENT CARDIAC EVENTS
LESLIE S. HUDSON, CHARLES F. BOOZE, JR., and AUDIE W. DAVIS Aug. 1990 8 p
(AD-A226596; DOT/FAA/AM-90/7) Avail: NTIS HC/MF A02 CSCL 06/5

The identification of risk factors for adverse cardiac events is valuable to the certification of airmen. This study examines the importance of right bundle branch block (RBBB) as a risk for myocardial infarction (MI), atherosclerotic heart disease (ASHD) and coronary heart disease (CHD). Using a non-concurrent prospective design, 433 Class 1 airmen between the ages of 35 and 60 years who had an RBBB on their electrocardiogram (ECG) in 1970 were matched to 338 control Class 1 airmen who had no abnormalities on their 1970 ECG. Using the longitudinal database maintained by the Federal Aviation Administration (FAA), the medical records of these airmen were screened for MI, ASHD, and CHD through the end of 1985. Questionnaires were sent to airmen with incomplete data on the computerized database. The first occurrence of any of these outcomes was considered an adverse cardiac event. In the case group, 24 cardiac events occurred (3.93/1,000 person-years) compared with 9 events in the control group (1.87/1,000 person-years). The relative risk was 2.012 with 95 percent confidence intervals of .994 to 4.484. The findings suggest an increased risk of adverse cardiac events but are of borderline statistical significance. GRA

53

BEHAVIORAL SCIENCES

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

A91-14069#
INTERACTION WITHIN A COMPLEX OF ANIMALS AND SMALL SOCIAL GROUPS IN EXPERIMENTAL ISOLATION
J. SYKORA, J. DVORAK, P. GADOUREK, J. HAVLOVA, M. JAKOUBEK (Ceskoslovenska Akademie Ved, Fyziologicky Ustav, Prague, Czechoslovakia) et al. IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p.
(IAF PAPER 90-539) Copyright

The paper discusses problems of interaction within a complex of two groups of human volunteers, the experiment controlling group and a group of animals (hens, quails, fishes) during three weeks of experimental isolation in a special underground installation. Means of decreasing developing tensions are discussed. Any small social group is considered as a closed information system. During the experiment internal tensions increase. These are taken as some form of social entropy. Opening the closed information system into another one releases social entropy and decreases emotional tensions within the group. Such

draining of entropy is possible into the experiment control group, into the animal group, and possibly into a computerized artificial intelligence group. Author

A91-14169#
REFLECTION OF INFLIGHT-PHYSICAL, MENTAL, AND EMOTIONAL STRESS BY PITCH CHARACTERISTICS OF THE VOICE OF OPERATORS
H. VAIC (Institute of Aviation Medicine, Koenigsbrueck, Federal Republic of Germany) and A. V. NIKONOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(IAF PAPER 90-535) Copyright

The influence of flight factors on physical and acoustic paramaters of speech during radio communication is investigated in order to evaluate the emotional stress of the operator. Radio communication under different acoustic, inflight-physical, and psychic conditions including environmental noise, physical exercise, mental stress, +Gz acceleration, Coriolis acceleration, and emotional tension was investigated. Investigations were conducted either during flight or under simulated aeromedical conditions. It is found that the emotional stress in dangerous situations increases the basic frequency of speech by approximately 400 percent. For all the other flight factors the variation is about 130 percent. An increase of more than 50 percent is generally considered to indicate emotional tension. B.P.

A91-14171#
PSYCHO-PHYSIOLOGICAL STUDIES WITH HELP OF 'STRESS-TESTER' UNDER DECOMPRESSIONS CONDITIONS IN MAN
H.-U. BALZER, K. HECHT, E. WACHTEL (Berlin, Humboldt-Universitaet, Federal Republic of Germany), and V. KATUNTSEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 4 p.
(IAF PAPER 90-538)

The feasibility of using the dynamics of electric skin resistance (ESR) to measure emotional response to decompression was investigated in three subjects exposed to decompression at simulated altitudes of 8100 and 11,000 m. The ESR values were transformed onto respective frequency of impulses, and their intervals were measured and stored in a computer; the obtained time series were analyzed biorhythmometrically. The ESR dynamics was found to be organized by rhythmic changes with periods between 20 and 140 msec. It was found that a transfer to decompression conditions was accompanied by ESR dynamics dominated by short periods, while the return to normal conditions resulted in relaxation and longer prevailing periods. It was also found that rhythmic ESR instabilities correlated with pain complaints, medical treatments, and increased work loads. I.S.

A91-14172#
SYSTEM ANALYSIS OF CRITICAL CHANGES IN SPACEMEN'S (OPERATOR'S) MENTAL PROCESSES UNDER EXTREME CONDITIONS OF LIFE AND ACTIVITY
O. MIKSIK, V. BRICHACEK, I. STETOVSKA, P. BOSCHEK, and K. RUZICKA (Karlova Universita, Prague, Czechoslovakia) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p.
(IAF PAPER 90-540) Copyright

A 'PSYCHOLAB' system enabling the apprehension and on-line evaluation of the structure and dynamics of personality mental autoregulation changes in relation to contextual situations under the extreme conditions of space flights is presented. On the basis of an interactive approach to mental working abilities, the resistance and failure of small groups and individuals in true situational applications are studied. It is shown that the system of actual mental states, dynamical changes in basic mental functions, and qualitative aspects of activities performed are adequately sensitive indicators of the quality of mental working abilities or of critical alterations of the individual's mental integrity. R.E.P.

A91-14173#
TIME AND MASS PERCEPTION IN NON-TERRESTRIAL ENVIRONMENTS
WILLIAM B. ALBERY and DANIEL W. REPPERGER (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 10 p. refs
(IAF PAPER 90-534)

This paper summarizes the results of five separate experiments conducted in space (microgravity) and on a human centrifuge (macrogravity). The experiments involved both time and mass perception of humans in these nonterrestrial environments. In the time perception experiments, subjects were asked to judge the arrival time of an object moving across a video screen; the task difficulty included obscuring a portion of the display and changing object speeds. In the mass perception experiments, subjects were given a set of objects of identical size but differing mass and asked to compare the weight of one object at a time against a standard. It was found that both time and mass perception are impaired in nonterrestrial environments. Time perception is significantly impaired in microgravity as well as macrogravitry (5 Gz). Microgravity was found to be more detrimental to mass discrimination than macrogravity at least up to 4 Gz. The time and mass perception behaviors observed in this research may be implicated in human factors problems observed in both space and aircraft operations. Author

A91-14223
THE ROLE OF DISPARITY-SENSITIVE CORTICAL NEURONS IN SIGNALLING THE DIRECTION OF SELF-MOTION
JEAN-PIERRE ROY and ROBERT H. WURTZ (NIH, National Eye Institute, Bethesda, MD) Nature (ISSN 0028-0836), vol. 348, Nov. 8, 1990, p. 160-162. refs
Copyright

Neurons have been found in the cerebral cortex of monkeys that prefer one direction of motion when the disparity of a stimulus corresponds to foreground motion and prefer the opposite direction when the disparity corresponds to background motion. It is proposed that these neurons contribute a signal about the direction of self-motion. C.D.

A91-14233#
ORGANIZATION, SELECTION, AND TRAINING OF CREWS FOR EXTENDED SPACEFLIGHT - FINDINGS FROM ANALOGS AND IMPLICATIONS
JOHN M. NICHOLAS (Loyola University, Chicago, IL) and H. CLAYTON FOUSHEE (FAA, Washington, DC) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept-Oct. 1990, p. 451-456. refs
Copyright

Ample research evidence from space analogs points to the crucial role that teamwork plays in the performance of small groups in isolation and confinement. This paper surveys findings about the impacts of group behavior and social interaction on crew morale, coordination, and productivity. Implications for the organization, selection, and training of crews for extended spaceflight are discussed. Author

A91-14234#
PSYCHOLOGICAL, PSYCHIATRIC, AND INTERPERSONAL ASPECTS OF LONG-DURATION SPACE MISSIONS
NICK KANAS (USVA, Medical Center, San Francisco, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept-Oct. 1990, p. 457-463. refs

Through an analysis of reports from manned American and Soviet space missions and earth-bound simulations, several psychological, psychiatric, and interpersonal issues can be identified that could affect the success of the Space Station and other long-duration space ventures. Psychological issues include sleep problems, alteration in time sense, demographic effects, career motivation, transcendent experiences, homesickness, and alteration in perceptual sensitivities. Psychiatric issues include

anxiety, depression and psychosis, psychosomatic symptoms, emotional problems related to the stage of the mission, and postflight personality changes. Interpersonal issues include interpersonal tension, decreased cohesiveness over time, need for privacy, and task vs emotional leadership. Steps can be taken to minimize the impact of these issues, both before and during the mission. Author

A91-14235#
PROBLEMS OF INTERGROUP BEHAVIOR IN HUMAN SPACEFLIGHT OPERATIONS
LARRY W. PENWELL (Mary Washington College, Fredericksburg, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept-Oct. 1990, p. 464-470. refs
Copyright

This paper discusses intergroup dynamics in human spaceflight operations. A definition of intergroup behavior is presented, and prerequisite conditions for intergroup conflict are explored. Research and anecdotal evidence of intergroup conflict between groups and subgroups in exotic environments and space operations is presented. Concepts from the literature on intergroup conflicts are discussed in the context of possible conflict resolution interventions. Factors that may affect intergroup dynamics in human spaceflight operations and the need for intergroup research are highlighted. Author

A91-14236#
PSYCHOSOCIAL EFFECTS OF ADJUSTMENT IN ANTARCTICA - LESSONS FOR LONG-DURATION SPACEFLIGHT
LAWRENCE A. PALINKAS (California, University, La Jolla) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept.-Oct. 1990, p. 471-477. refs
(Contract NSF DPP-87-16461)
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This paper examines the utility of remote, isolated Antarctic research stations as analogs for long-duration spaceflights from the perspective of psychosocial processes of adaptation and adjustment. Biomedical research in Antarctica provides an opportunity to study the cause of these changes and to develop strategies for reducing the risks to health and well-being before they pose a serious threat to crew safety and mission success. Lessons for long-duration spaceflight include screening and selection of personnel; training programs designed to facilitate individual adjustment and group adaptation and minimize group conflict; identification of optimal leadership characteristics for small, isolated groups; an understanding of social dynamics and group 'microcultures' necessary for the organization and management of small but heterogeneous groups; organization of work activities; facility design; and support infrastructure. Author

A91-14238*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PSYCHOLOGICAL HEALTH MAINTENANCE ON SPACE STATION FREEDOM
PATRICIA A. SANTY (NASA, Johnson Space Center, Houston, TX) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept.-Oct. 1990, p. 482-485. refs
Copyright

The scheduling of crew rotations at intervals of as much as 180 days on NASA's Space Station Freedom entails that the cumulative effects of psychological, emotional, and social stressors on astronauts be monitored. The Space Station's Health Maintenance Facility (HMF) will furnish preventive, diagnostic, and therapeutic assistance for significant psychiatric and interpersonal problems. Mental health professionals must be part of the team of medical personnel charged with facilitating the physiological and phychological transition from earth to space and back. An account is presently given of the critical factors to be addressed by HMF personnel on extended-duration missions. O.C.

A91-14334
HUMAN FACTORS TRAINING FOR AVIATION PERSONNEL
D. E. MAURINO (International Civil Aviation Organization, Air Navigation Bureau, Montreal, Canada) and A. N. JOHNSTON ICAO Journal (ISSN 0018-8778), vol. 45, May 1990, p. 16-19.
Copyright

The background to the new human factors training requirement introduced by ICAO in November 1989 is reviewed and general issues relevant to curriculum design and implementation of human factors training courses are discussed. Disciplines frequently involved in human factors are listed as psychology, engineering, human physiology, medicine, sociology, and anthropometry. A brief review of the Human Factors Digest is presented. The digest discusses the philosophical approach, the conceptual approach, and the software/hardware/environment/liveware (SHEL) model, which provides a conceptual framework and helps to illustrate the various 'interfaces' or points of interaction between different subsystems in operational process. A 35 h pilot training course in human factors which explicitly addresses issues relating to crew communication, coordination, and management is discussed, with particular attention to curriculum development and trainee performance appraisal. L.K.S.

A91-14746
DISPLAY PRINCIPLES, CONTROL DYNAMICS, AND ENVIRONMENTAL FACTORS IN PILOT TRAINING AND TRANSFER
GAVAN LINTERN, JONATHAN E. SIVIER (Illinois, University, Savoy), and STANLEY N. ROSCOE (ILLIANA Aviation Sciences, Las Cruces, NM) Human Factors (ISSN 0018-7208), vol. 32, June 1990, p. 299-317. refs
(Contract N00014-87-K-0435)
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Sixty-four flight-naive men were tested in a fractional factorial, quasi-transfer experiment to examine the effects of four display factors, one control response factor, and one environmental factor on acquisition and transfer of aircraft landing skills. An additional 12 trainees served as experimental controls. Transfer was measured from each of 64 experimental training conditions to a criterion condition with a conventional inside-out pictorial contact display, normal simulator control dynamics, and a 5-knot crosswind. Transfer was better following training with pictorial displays than with symbolic displays, and with normal rather than reduced bank control order. Interactions of crosswind with predictive augmentation and with bank control order showed that for some conditions, transfer benefited from training with predictive augmentation and from training without crosswind. Author

A91-14747
TRANSFER OF LANDING SKILLS IN BEGINNING FLIGHT TRAINING
GAVAN LINTERN, JEFFERSON M. KOONCE, LEON D. SEGAL (Illinois, University, Savoy), and STANLEY M. ROSCOE (ILLIANA Aviation Sciences, Las Cruces, NM) Human Factors (ISSN 0018-7208), vol. 32, June 1990, p. 319-327. refs
(Contract N00014-87-K-0435)
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Beginning flight students from the University of Illinois flight training program were given two sessions of landing practice in a simulator with a computer-animated contact landing display before they commenced intensive landing practice in the aircraft. For each experimental student there was a control student, paired with the same instructor, who received no landing practice in the simulator. Experimental students required significantly fewer presolo landings in the airplane than did the paired controls, representing a potential saving of about 1.5 presolo flight hours per student. These data show that pretraining with a moderately detailed, yet relatively inexpensive, computer-animated landing display can offer worthwhile savings in flight time. Some students were provided adaptive visual augmentation during their simulator training, and there was evidence of incremental transfer attributable to this instructional feature. Author

A91-16275
INFLUENCE OF COLOUR ON THE PERCEPTION OF COHERENT MOTION

JOHN KRAUSKOPF and BART FARELL (New York University, NY) Nature (ISSN 0028-0836), vol. 348, Nov. 22, 1990, p. 328-331. Research supported by NIH and USAF. refs
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Color vision is possible because there are three types of cone photoreceptors which are maximally sensitive in the long (L), middle (M), and short (S) wavelength regions of the spectrum. Psychophysical experiments have, however, revealed mechanisms selectively responsive to light modulated in three 'cardinal directions' in color space. The responses of these mechanisms are determined by algebraic sums of the excitations of the cones. One of these mechanisms is responsive to changes in luminance, its spectral sensitivity being that of the sum of the L and M cones. The other two respond best to isoluminant changes in light. The responses of one of these mechanisms are determined by the difference in the excitations of the L and M cones, and those of the other one determined by the difference between the excitation of the S cones on the one hand and the excitations of the L and M cones on the other. This paper presents results concerning the role of these mechanisms in the perception of motion. Drifting gratings modulated along different cardinal directions appear to slip with respect to one another. In contrast, when the directions of the modulations are rotated by 45 deg in color space, the gratings cohere. These results are consistent with the notion that information about movement is analyzed within mechanisms maximally responsive along the cardinal directions. Author

A91-16282#
LESSONS LEARNED CONCERNING THE INTERPRETATION OF SUBJECTIVE HANDLING QUALITIES PILOT RATING DATA
ROGER H. HOH (Hoh Aeronautics, Inc., Lomita, CA) AIAA, Atmospheric Flight Mechanics Conference, 8th, Portland, OR, Aug. 20-22, 1990. 12 p. refs
(AIAA PAPER 90-2824) Copyright

The subjected pilot rating process, and interpretations of the resulting data and pilot opinions of aircraft handling qualities are reviewed. Training effects, and the effects of vested interests on the part of the evaluation pilots are discussed in terms of subjective evaluations of a specific aircraft vs. generic variations in the research environment. Recommendations are made regarding experimental techniques that are known to minimize pilot rating scatter. Author

A91-16284#
MORE ON COOPER-HARPER PILOT RATING VARIABILITY
DAVID R. RILEY and DAVID J. WILSON (McDonnell Aircraft Co., Saint Louis, MO) AIAA, Atmospheric Flight Mechanics Conference, 8th, Portland, OR, Aug. 20-22, 1990. 11 p. refs
(AIAA PAPER 90-2822) Copyright

Flying qualities experiments rely on Cooper-Harper pilot rating as well as pilot comments to determine desirable aircraft dynamics. Unfortunately, several sources of experimental variation affect Cooper-Harper rating data. Among these are lack of pilot repeatability, individual pilot preferences, interpretation of the Cooper-Harper rating scale wording, poor experimental setup, or insufficient evaluation time. Cooper-Harper rating variability reduces the engineer's confidence in the results and increases the cost of an experiment by necessitating repeat ratings. Experimental procedures have been developed to reduce or minimize the effects of pilot rating variability and increase confidence in experimental findings. Author

A91-16682#
POWER SPECTRAL ANALYSIS TO INVESTIGATE THE EFFECTS OF SIMULATOR TIME DELAY ON FLIGHT CONTROL ACTIVITY
MATTHEW S. MIDDENDORF, STEVEN L. LUSK (Logicon Technical Services, Inc., Dayton, OH), and JAMES D. WHITELEY (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1990, p. 46-52. refs
(AIAA PAPER 90-3127)

In a recent experiment at the Armstrong Aerospace Medical Research Laboratory, test subjects were instructed to perform a sidestep landing maneuver in a flight simulator with time delays of 90ms, 200ms, and 300ms. The baseline delay condition was 90ms and additional delays were added to the visual display loop to yield the 200ms and 300ms delay conditions. Power spectral analysis on lateral stick activity showed that power in a narrow band (0.4 to 0.5 Hz) increased as time delay increased. This increased power is examined and it is determined that, as time delay increased, the man-machine system became less stable and less damped. Thus, the subjects needed to make additional control inputs to correct for overshoot and degraded stability. Author

A91-16722*# Mitre Corp., Houston, TX.
CHALLENGES IN THE 1990'S FOR ASTRONAUT TRAINING SIMULATORS
PATRICK M. BROWN, ANKUR R. HAJARE, and GEORGE E. STARK (Mitre Corp., Houston, TX) AIAA, Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990. 8 p. refs
(Contract NAS9-18057)
(AIAA PAPER 90-3125)

New challenges for the simulation community at the Johnson Space Center both in near and long terms are considered. In the near term, the challenges of supporting an increasing flight rate, maintaining operations while replacing obsolete subsystems, and incorporating forthcoming changes to the Space Shuttle are discussed, and focus is placed on a change of forward flight-deck instruments from electro-mechanical devices to electronic displays. Training astronauts for complex concurrent missions involving multiple spacecraft and geographically dispersed ground facilities is considered to be foremost of the long-term challenges, in addition to the tasks of improving the simulator reliability and the operational efficiency of the facilities. V.T.

N91-11760# Technische Univ., Delft (Netherlands).
DEVELOPMENTS IN MATHEMATICAL MODELS OF HUMAN PILOT BEHAVIOR
O. H. GERLACH *In its* Essays on Stability and Control 27 p Oct. 1989
Avail: NTIS HC/MF A12

Attention is paid to the physiological and psychological parts of the pilot's task, the processing of sensed data and decision making. Two engineering pilot models which are used on a wide scale, the cross-over model and the optimal control model are presented. A biomorphic model is discussed with the aim of describing how the data handling and decision making processes going on in the pilot's brain may be modeled mathematically along with the control process proper on which existing models concentrate. This model aims at obtaining a closer and more detailed mathematical description of what actually goes on in the living organism. The use of models in the evaluation of aircraft handling qualities is addressed. ESA

N91-11766# Technische Univ., Delft (Netherlands).
VISUAL-VESTIBULAR INTERACTION IN PILOT'S PERCEPTION OF AIRCRAFT OR SIMULATOR MOTION
R. J. A. W. HOSMAN and J. C. VANDERVAART *In its* Essays on Stability and Control 24 p Oct. 1989
Avail: NTIS HC/MF A12

The importance of man's vestibular organs in perceiving cockpit motion in an aircraft or a simulator is nowadays hardly questioned, as witnessed by the present widespread use of six degrees of freedom motion systems for flight simulators. Still more advantages could be gained from the use of moving base simulators. To illustrate this, research on control behavior and performance of subjects in target following and disturbance tasks is reviewed. By using results of work by the authors and by others, the importance of peripheral visual and vestibular motion perception in tasks that require inner-loop stabilization, is emphasized. Results of stimulus response experiments, especially designed to gather insight in

central and peripheral visual and vestibular perception of motion are summarized and used to explain findings of tracking experiments. It is concluded that peripheral visual and cockpit motion cues are of paramount importance in actual or simulated manual aircraft control and that, in simulation, the compensation for simulator motion system dynamics, computing time delays and motion control laws deserve much more attention. ESA

N91-12199*# Lockheed Space Operations Co., Cocoa Beach, FL.
REMOTE VOICE TRAINING: A CASE STUDY ON SPACE SHUTTLE APPLICATIONS, APPENDIX C
CINDY MOLLAKARIMI and TAMIN HAMID 1990 10 p
(Contract NCC10-001)
(NASA-CR-187385; NAS 1.26:187385) Avail: NTIS HC/MF A02 CSCL 05/9

The Tile Automation System includes applications of automation and robotics technology to all aspects of the Shuttle tile processing and inspection system. An integrated set of rapid prototyping testbeds was developed which include speech recognition and synthesis, laser imaging systems, distributed Ada programming environments, distributed relational data base architectures, distributed computer network architectures, multi-media workbenches, and human factors considerations. Remote voice training in the Tile Automation System is discussed. The user is prompted over a headset by synthesized speech for the training sequences. The voice recognition units and the voice output units are remote from the user and are connected by Ethernet to the main computer system. A supervisory channel is used to monitor the training sequences. Discussions include the training approaches as well as the human factors problems and solutions for this system utilizing remote training techniques. Author

N91-12200# Tennessee Univ., Knoxville. Dept. of Psychology.
VALIDITY MEASURES IN THE CONTEXT OF LATENT TRAIT MODELS Technical Report, 1987 - 1990
FUMIKO SAMEJIMA 15 Jun. 1990 25 p
(Contract N00014-87-K-0320; NR PROJ. RR0-4204)
(AD-A224695; ONR-RR-90-3) Avail: NTIS HC/MF A03 CSCL 12/3

In contrast to the progressive desolution of the reliability coefficient in classical mental test theory and the replacement by the test information function in latent trait models, the issue of test validity has been more or less neglected in modern mental test theory. Some considerations are provided about the validity of a test and of a single item. Effort has been focused upon searching for measures which are population-free, and which will provide us with local and abundant information just as the information functions do in comparison with the test reliability coefficient in classical mental test theory. In so doing, validity indices for different purposes of testing and also those which are tailored for a specific population of examinees are considered. GRA

N91-12201# Tennessee Univ., Knoxville. Dept. of Psychology.
PREDICTIONS OF RELIABILITY COEFFICIENTS AND STANDARD ERRORS OF MEASUREMENT USING THE TEST INFORMATION FUNCTION AND ITS MODIFICATIONS Technical Report, 1987 - 1990
FUMIKO SAMEJIMA 30 Jun. 1990 27 p
(Contract N00014-87-K-0320; NR PROJ. RR0-4204)
(AD-A224696; ONR-RR-90-2) Avail: NTIS HC/MF A03 CSCL 05/8

There seems to be a concensus that two main measures in classical mental test theory are the reliability and validity coefficients of a test. Although these measures have widely been accepted by psychologists and test users in the past decades, they are actually the attributes of a specified group of examinees as well as of a given test, since the correlation coefficient is used in either case. In addition, representation of these measures by single numbers results in over simplification and the lack of useful information for both theorists and actual users of tests. The same applies for the standard error of measurement also. In latent trait models, the item and test information functions provide us with abundant information about the local accuracy of estimation, a concept which is totally missing in classical mental test theory. These functions do not depend upon any specific group of examinees as the reliability coefficient does, or it can be said that they are population-free. By virtue of this characteristic, adding further information about the MLE bias function of the test and the ability distribution of the examinee group, the tailored reliability coefficient and standard error of measurement can be provided in the classical mental test theory's sense for each and every specified group of examinees who have taken the same test. GRA

N91-12202# Naval Postgraduate School, Monterey, CA.
AN ANALYSIS OF THE EFFECT OF FREQUENCY OF TASK PERFORMANCE ON JOB PERFORMANCE MEASUREMENT M.S. Thesis
RICK L. REECE Mar. 1990 69 p
(AD-A225304) Avail: NTIS HC/MF A04 CSCL 05/9

The effect is explored of frequency of performance on the Congressionally mandated Job Performance Measurement, specifically the Marine Corps' portion of the study. The initial portion of the project involved the hands-on performance testing of the infantry specialities. The use is validated of the general technical (GT) composite of the Armed Services Vocational Aptitude Battery (ASVAB) test as a predictor of performance in the infantry specialty and to provide recommendations to revise training priorities. The approach in analyzing the problem included the following: (1) computing the correlation between aptitude and performance, then investigating any degrading or moderating effect that frequency might have on this relationship; (2) an investigation into the performance of high aptitude personnel versus low aptitude personnel across frequency categories; and (3) the relative effect of frequency on the maintenance of proficiency in each task. The use was validated of the GT composite as an effective predictor for hands on performance by performing analysis of variance. An interesting result was the determination that frequency is the major predictor for performance based tasks requiring continual practice for the maintenance of skill levels, while recency is the major factor in predicting tasks that are more knowledge based and require the recall of detailed procedures. GRA

N91-12203# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
LIMITS OF PRECISION FOR HUMAN EYE MOTOR CONTROL
MANFRED FAHLE Nov. 1989 22 p Prepared in cooperation with the Center for Biological Information Processing, Whitaker College
(Contract N00014-85-K-0124)
(AD-A225515; AI-M-1209; CBIP-48) Avail: NTIS HC/MF A03 CSCL 06/4

If the two segments of a vernier target are presented to different eyes (dichoptically, thresholds are three to four times higher than with presentation to the same eye), the increase in thresholds is mainly due to uncorrelated movements of both eyes, such as tremor and drifts, that occur even under steady fixation. The psychophysically measured thresholds allow one to calculate an upper estimate for the amplitudes of uncorrelated eye movements during fixation. This estimate matches the best results from direct eye position recording, with the calculated mean amplitude of eye tremor corresponding to roughly one photo-receptor-diameter. The combined amplitude of both correlated and uncorrelated eye movements was also measured by delaying one segment of the vernier relative to its partner under monocular or dichoptic conditions. Fixation proved to be relatively stable, and trained observers could sustain eye position within a few arcmin. GRA

N91-12204# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
QUALITATIVE REASONING: HOW WE THINK OUR WAY THROUGH THE DAY
HERBERT A. SIMON 1 Mar. 1990 17 p Prepared in cooperation

with Pittsburgh Univ., PA
(Contract N00014-86-K-00678; F33615-84-K-1520)
(AD-A225646; AIP-130) Avail: NTIS HC/MF A03 CSCL 05/8

We have come full circle back to the topic of visualization and the role of the mind's eye and of external visual displays in human thinking. I have tried to survey some of the main tools and processes that seem to be implicated in everyday reasoning -- the kind that carries us through the day, dealing with problems as they arise. The thinking I have described does not look at all like formal logic, and only a little like mathematics. It makes use of a great multitude of inference rules, which are not tautological rules of logic but incorporate much real-world knowledge. It appears to be remarkably unconcerned with questions of sufficiency and necessity. When it deals with quantities, as if often must, it usually handles primarily their ordinal rather than their cardinal properties. For most people, at least, it makes great use of diagrammatic representations, or mental diagrams in the mind's eye, which provide it with powerful inference processes. To compensate for its severe limitations in handling simultaneous relations, it proceeds by successive approximations, and halts when it has satisfied. By the standards of formal logic, it is a jerry-built structure. But it gets us through the day. GRA

N91-13066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TECHNICAL ASPECTS OF A DEMONSTRATION TAPE FOR THREE-DIMENSIONAL SOUND DISPLAYS
DURAND R. BEGAULT and ELIZABETH M. WENZEL Oct. 1990 22 p
(NASA-TM-102826; A-90162; NAS 1.15:102826) Avail: NTIS HC/MF A03 CSCL 05/9

This document was developed to accompany an audio cassette that demonstrates work in three-dimensional auditory displays, developed at the Ames Research Center Aerospace Human Factors Division. It provides a text version of the audio material, and covers the theoretical and technical issues of spatial auditory displays in greater depth than on the cassette. The technical procedures used in the production of the audio demonstration are documented, including the methods for simulating rotorcraft radio communication, synthesizing auditory icons, and using the Convolvotron, a real-time spatialization device. Author

N91-13067# Retina Foundation, Boston, MA. Eye Research Inst.
EYE MOVEMENTS AND SPATIAL PATTERN VISION Annual Report, 1 May 1989 - 30 Apr. 1990
LAWRENCE E. AREND 15 Jul. 1990 13 p
(Contract AF-AFOSR-0377-89; AF PROJ. 2313)
(AD-A225357; AFOSR-90-0810TR) Avail: NTIS HC/MF A03 CSCL 06/4

Models of human lightness and color perception must take account of color constancy, a tendency for apparent surface color to be relatively independent of the color and intensity of the illuminating light source. Our observers matched the lightness (apparent reflectances) and brightnesses (apparent luminances) of regions in simple and complex achromatic spatial patterns. The data showed that the observers' knowledge of the surface reflectances was unaffected by brightness changes due to varying illuminance. A third perceptual dimension, local brightness contrast, was different from both lightness and brightness. In further experiments we found that moving a patch from a black background to a white background could produce an error of apparent surface color of about 1.5 Munsell Value steps. Similar experiments at mesopic mean luminances revealed that the brightness contrast produced by a fixed luminance contrast declines with mean luminance. GRA

N91-13068# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
CONTROLLING SEARCH DYNAMICS BY MANIPULATING ENERGY LANDSCAPES
DAVID S. TOURETZKY Dec. 1989 30 p Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678; NSF EET-87-16324)
(AD-A225719; AIP-111; CMU-CS-89-113) Avail: NTIS HC/MF A03 CSCL 05/8

Touretzky and Hinton's DCPS (Distributed Connectionist Production System) is a neural network with complex dynamical properties. Visualization of the energy landscapes of some of its component modules leads to a better intuitive understanding of the model. Three visualization techniques are examined. Analysis of the way energy landscapes change as modules interact during an annealing search suggests ways in which the search dynamics can be controlled, thereby improving the model's performance on difficult match cases. GRA

N91-13069# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE EFFECT OF INDEXING ON THE COMPLEXITY OF OBJECT RECOGNITION Memorandum Report
W. ERIC L. GRIMSON Apr. 1990 30 p
(Contract N00014-86-K-0685; N00014-85-K-0124; DACA76-85-C-0010; NSF IRI-89-00267)
(AD-A225761; AI-M-1226) Avail: NTIS HC/MF A03 CSCL 12/9

Many current recognition systems use constrained search to locate objects in cluttered environments. Previous formal analysis has shown that the expected amount of search is quadratic in the number of model and data features, if all the data is known to come from a single object, but is exponential when spurious data is included. If one can group the data into subsets likely to have come from a single object, then terminating the search once a good enough interpretation is found reduces the expected search to cubic. Without successful grouping, terminated search is still exponential. These results apply to finding instances of a known object in the data. In this paper, we turn to the problem of selecting models from a library, and examine the combinatorics of determining that a candidate object is not present in the data. We show that the expected search is again exponential, implying that naive approaches to indexing are likely to carry an expensive overhead, since an exponential amount of work is needed to weed out each of the incorrect models. The analytic results are shown to be in agreement with empirical data for cluttered object recognition. GRA

N91-13070# Chicago Univ., IL. Center for Decision Research.
DECISION MAKING UNDER UNCERTAINTY: THE EFFECTS OF ROLE AND AMBIGUITY Technical Report No. 25, 15 Mar. - 14 Jun. 1990
ROBIN M. HOGARTH and HOWARD KUNREUTHER (Pennsylvania State Univ., University Park.) May 1990 45 p Revised Sponsored by NSF and Sloan Foundation
(Contract N00014-84-C-0018; NR PROJ. RR0-4209)
(AD-A225771) Avail: NTIS HC/MF A03 CSCL 05/1

In many important decisions, people are uncertain or ambiguous concerning the magnitude of the probabilities of events that can affect outcomes. The classic theory of decision making argues that people's decisions should not be affected by whether knowledge of a probability is precise or ambiguous. This chapter presents a descriptive model of how people cope with ambiguous probabilities in decision making. The model predicts that ambiguity matters. 'Decision weights' associated with ambiguous probabilities are assumed to be reached via an anchoring-and-adjustment process in which people anchor on an estimate of the probability and then adjust this as a result of mentally stimulating alternative values of the probability. The mental simulation process is affected by both the amount of ambiguity and whether outcomes are large or small gains and/or losses. One important factor that determines people's attitudes toward ambiguity is the nature of the role they assume in making decisions. GRA

N91-13071# Haifa Univ. (Israel).
ENHANCING PERFORMANCE UNDER STRESS BY INFORMATION ABOUT ITS EXPECTED DURATION Final Report, Feb. 1988 - Feb. 1989
SHLOMO BREZNITZ Jul. 1990 28 p

(Contract DAJA45-86-C-0048)
(AD-A225889; ARI-RN-90-36) Avail: NTIS HC/MF A03 CSCL 05/8

For this report, the effect of False Short and False Long Information (with subsequent correction) on endurance of the Cold Pressor Test (CPT) was studied using more extreme information manipulations than the ones tested during the first year. On the basis of a specific experiment that investigated hand effects and order effects in the CPT paradigm, it was possible to use a combined between- and within-subjects design. Endurance in the False Short condition was significantly higher than in the False Long one. In another experiment, most subjects endured the pain longer in the No Control than in the Control conditions. The implications of these results to military situations were discussed. A pilot field experiment with marching soldiers tested some of the above factors in a real-life military context. False Long information at the start of the march led to significant breakdown under the strain. GRA

N91-13072# Army Armament Research and Development Command, Dover, NJ. Fire Support Armament Center.
METHODS FOR IDENTIFYING OBJECT CLASS, TYPE, AND ORIENTATION IN THE PRESENCE OF UNCERTAINTY
RUSSELL TAYLOR, ANTHONY P. REEVES, and FRANK P. KUHL Aug. 1990 37 p
(AD-A225984; ARFSD-TR-90007) Avail: NTIS HC/MF A03 CSCL 12/9

Techniques are presented for identifying unoccluded three-dimensional objects from arbitrary viewing angles in the framework of a model-based feature vector classification scheme. Fourier descriptors and moments are used for feature vector generation from contour imagery and silhouette and/or range imagery, respectively. A class of objects, airplanes, is defined with six distinct example types in our test data set. An additional data set of four objects from this class is also defined. A method for generating an exhaustive set of library views and worst case test views has been developed using a polyhedral approximation to a sphere. Based on matching to this library, object class membership, type, and orientation are determined. An approach called classification quality assessment (CQA) is applied to this recognition paradigm to both assess and deal with uncertainty. This is a two level process: the first rejects objects that are not members of a known class and therefore not contained in the model database, while the second identifies the likelihood of error for classification of known object type and/or orientation (within class errors). Both use simple measures that were generated solely from the system's priori knowledge. GRA

N91-13073# Signal Analytics Corp., Vienna, VA.
A METHOD OF ANALYZING AIR SYSTEM PERFORMANCE BASED ON SHAPE DISTORTION Final Report, 24 Aug. 1989 - 30 Apr. 1990
MICHAEL STEVEN MORT 5 May 1990 61 p
(Contract DAAL03-89-C-0033)
(AD-A226193; GF006-F; ARO-26842.1-EL-SBI) Avail: NTIS HC/MF A04 CSCL 12/9

This research developed a measure, called the Maximum Resolvable Polygon (MRP), which estimates the degree of shape distortion introduced by an imaging system. The MRP relies on a computer simulation of the imaging system. While such a computer simulation requires more extensive computer power than the computation of an analytical formula like the MRT, the MRP may still be considered relatively easy to compute. All software simulations and experiments reported were performed on a personal computer. A new test pattern set is n proposed to replace the bar pattern which is used to analyze the performance of man-in-the-loop systems. Target-like test patterns rely on the use of regular polygons and are parameterized by the number of sides in the polygons. Clutter-like objects are also derived from this test pattern set. A theoretical analysis of the MRP indicates that it estimates the target shape conditions at which a target recognition system will produce a 50 percent error rate. Simulation experiments have compared the performance which the MRP measure predicts that an automatic target recognition system would have with the performance of the human visual pattern recognition system. GRA

N91-13074# Amherst Systems, Inc., Buffalo, NY. Dept. of Electrical and Computer Engineering.
FOVEAL MACHINE VISION SYSTEMS Ph.D. Thesis
CESAR BANDERA 1 Aug. 1990 293 p
(Contract DASG60-89-C-0075)
(AD-A226274; REPT-605-9160001) Avail: NTIS HC/MF A13 CSCL 12/9

This work presents a new class of active machine vision systems, called foveal machine vision systems, which feature space variant sampling directed by gaze strategies. Two families of space variant sampling geometries are analyzed with spatial resolution decreasing with distance from the optical axis. One family features a linear acuity roll-off, and the other an exponential roll-off. Techniques are presented for the integration of sensor frames into unified static scene perceptions. Foveal systems can use many existing hierarchical processing techniques, in particular image pyramid structures and algorithms. A hierarchical structure called the foveal polygon is described. The foveal polygon is the subset of an image pyramid supported by foveal sensor frame. Top-down (coarse-to-fine) algorithms processing polygon data serve as drivers for gaze control. Additional gaze control strategies are presented for general learning and surveying (minimization of hypothesis entropy), and feature interrogation (hypothesis likelihood maximization). GRA

N91-13075# Rochester Univ., NY. Center for Visual Science.
PERIPHERAL LIMITATIONS ON SPATIAL VISION Interim Report, 1 Aug. 1989 - 31 Jul. 1990
DAVID R. WILLIAMS 16 Jul. 1990 10 p
(Contract AF-AFOSR-0292-88; AF PROJ. 2313)
(AD-A226335; AFOSR-90-0877TR) Avail: NTIS HC/MF A02 CSCL 06/4

This project employs psychophysical techniques to examine the limitations on spatial vision imposed by the first stages in the visual pathway. Many of the experiments capitalize on laser interferometry, which allows sinusoidal gratings to be formed on an observer's retina that are immune to optical blurring. The appearance of very high frequency gratings is distorted, or aliased, by the cone mosaic. Such moire patterns provide the basis for psychophysical techniques to assess the topography of the cone mosaic in the living eye. These measurements, accompanied by measurements of visual acuity clarify the relationship between cone spacing and resolution. Resolution was also measured under conditions in which only the M or L cones could detect the interference fringe. A small difference in visual acuity than it was when both cone types detected the grating, showing that resolution is immune to photoreceptor loss under these circumstances. An aliasing phenomenon caused by spatial sampling by M and L cones was also established. Interferometry also allows measurements of the optical quality of the eye, and a viable experimental design was established to estimate the off axis optical quality of the eye. GRA

N91-13328*# Montclair State Coll., Upper Montclair, NJ. Dept. of Psychology.
OPERATIONAL TESTING OF A FIGURE OF MERIT FOR OVERALL TASK PERFORMANCE
MOIRA LEMAY *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 p 79-80 Sep. 1990
Avail: NTIS HC/MF A07 CSCL 05/9

An overall indicator or figure of merit (FOM), for the quality of pilot performance is needed to define optimal workload levels, predict system failure, measure the impact of new automation in the cockpit, and define the relative contributions of subtasks to overall task performance. A normative FOM was developed based on the calculation of a standard score for each component of a complex task. It reflected some effects, detailed in an earlier study, of the introduction of new data link technology into the cockpit.

Since the technique showed promise, further testing was done. A new set of data was obtained using the recently developed Multi-Attribute Task Battery. This is a complex battery consisting of four tasks which can be varied in task demand, and on which performance measures can be obtained. This battery was presented to 12 subjects in a 20 minute trial at each of three levels of workload or task demand, and performance measures collected on all four tasks. The NASA-TLX workload rating scale was presented at minutes 6, 12, and 18, of each trial. A figure of merit was then obtained for each run of the battery by calculating a mean, SD, and standard score for each task. Each task contributed its own proportion to the overall FOM, and relative contributions changed with increasing workload. Thus, the FOM shows the effect of task changes, not only on the individual task that is changed, but also on the performance of other tasks and of the whole task. The cost to other tasks of maintaining constant performance on an individual task can be quantified. Author

54

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A91-13338* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
PAVING THE WAY FOR SPACE GARDENS
PATRICIA PHILLIPS (NASA, Kennedy Space Center, Cocoa Beach, FL) Spaceflight (ISSN 0038-6340), vol. 32, Nov. 1990, p. 354-356.
Copyright

The Ecological Life Support System, a plant growth experiment now in its third year of closed chamber production at the NASA Kennedy Space Center, is discussed. Possible spin-off applications of hydrophonics experiments are noted. It is projected that long-term goals will include the integration of this garden system into the process of waste recycling for fertilization, air refreshment, and potable water recovery in a closed environment. The Biomass Production Chamber, a two-story bubble-shape steel biosphere modified from a Mercury/Gemini program attitude chamber provides a usable volume of 7.3 m x 3.6 m in diameter containing growing racks, piping for nutrient solutions, specialized lighting and sensors that provide information to the computers controlling the chamber and its functions. Computer programs provide highly sensitive monitoring and regulation of the system. Crops successfully harvested to date include dwarf wheat, lettuce, and soybeans. L.K.S.

A91-13739#
TELEOPERATED AND AUTOMATIC OPERATION OF TWO ROBOTS IN A SPACE LABORATORY ENVIRONMENT
E. FREUND, CH. BUEHLER, and J. ROSSMANN (Dortmund, Universitaet, Federal Republic of Germany) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p. Research supported by BMFT. refs
(IAF PAPER 90-016) Copyright

A system concept for the control of robots in space by teleoperation is discussed. The concept uses a hierarchical structure which permits the incorporation of robots, manipulators, and hard-automated features on different levels of abstraction. The system's architecture is described, with special emphasis on the overall structure, autonomous operation, teleoperation support, collision avoidance, and a new group concept for multirobot systems. The feasibility of the approach is illustrated by the CIROS (Control of Intelligent Robots in Space) mockup, an experimental multirobot system with two redundant robots working together closely in a space laboratory environment. The sensory equipment and the communication infrastructure are described. C.D.

A91-13743*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COST-EFFECTIVE IMPLEMENTATION OF INTELLIGENT SYSTEMS
HENRY LUM, JR. (NASA, Ames Research Center, Moffett Field, CA) and EWALD HEER (Heer Associates, Inc., La Canada, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 10 p. refs
(IAF PAPER 90-021) Copyright

Significant advances have occurred during the last decade in knowledge-based engineering research and knowledge-based system (KBS) demonstrations and evaluations using integrated intelligent system technologies. Performance and simulation data obtained to date in real-time operational environments suggest that cost-effective utilization of intelligent system technologies can be realized. In this paper the rationale and potential benefits for typical examples of application projects that demonstrate an increase in productivity through the use of intelligent system technologies are discussed. These demonstration projects have provided an insight into additional technology needs and cultural barriers which are currently impeding the transition of the technology into operational environments. Proposed methods which addresses technology evolution and implementation are also discussed. Author

A91-13746#
EMATS, A ROBOT-BASED EQUIPMENT MANIPULATION AND TRANSPORTATION SYSTEM FOR THE COLUMBUS FREE FLYING LABORATORY
P. PUTZ (Dornier GmbH, Friedrichshafen, Federal Republic of Germany), G. COLOMBINA (Tecnospazio S.p.A., Milan, Italy), and W. DE PEUTER (ESTEC, Noordwijk, Netherlands) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(IAF PAPER 90-024) Copyright

This paper describes the concept for a robot-based Equipment Manipulation and Transportation System (EMATS) for the Columbus Free Flying Laboratory developed under ESA contact by a study team headed by Dornier. EMATS could not only automatically provide the greater part of the payload facility handling and logistics functions during the unmanned microgravity periods, but also perform unmanned servicing operations in conjunction with various logistics vehicles concepts and assist the crew during manned servicing from the Space Station Freedom and from Hermes. To that end, a variety of telerobotics feature are foreseen such as teleoperation and supervised automatic operation from ground or from a small control station aboard the Free Flyer, Hermes, or the S.S. Freedom. The paper summarizes the overall EMATS architecture and illustrates the flexibility of the concept by results from computer graphics simulations. Author

A91-13747#
THE HERMES ROBOT ARM - ADVANCES IN CONCEPTS AND TECHNOLOGIES
P. H. M. SCHOONEJANS (Fokker Space and Systems, Amsterdam, Netherlands), G. ANDRE, and G. DANAN (Matra Espace, Toulouse, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p. refs
(IAF PAPER 90-025) Copyright

Hera, the robot arm for external servicing of Hermes, is discussed. A general overview of Hera is given, covering its task and design concepts. The new concepts and technologies involved in the flight segment of the Hera project are examined, including those concerning collision detection, vision proximity sensing, advanced MMI. The relocatability of the Hera arm, which makes it an autonomous system which can exchange electrical signals with the rest of the world without being rigidly clamped to any other system, is examined. The switching between basepoints of the arm and the mechanism design of its end effector are examined. Finally, in-orbit assembly of Hera is discussed. C.D.

A91-13748#
HOW ARTIFICIAL INTELLIGENCE CAN IMPROVE MAN-MACHINE INTERFACE - PRACTICAL EXAMPLE WITH EXTRAVEHICULAR ACTIVITIES
P. DUPRAT, S. BERTHIER, P. NORY, J. P. GAUTIER, and J. R. CHEVALLIER (Dassault Aviation, Saint-Cloud, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p.
(IAF PAPER 90-026) Copyright

The integration of artificial intelligence into the man-machine interface of an EVA spacesuit is demonstrated. This EVA suit matches demonstration requirements with a medium-complexity system and highly constrained operations involving reduced mobility and visibility in a harsh environment. The main functions involved in information and control, communication, and data management are outlined, and the functionalities explored in the study are summarized. The roles of the media and information managers are discussed, and the system architecture and implementation are briefly addressed. C.D.

A91-13749#
VISUAL SENSING FOR AUTONOMOUS RENDEZVOUS AND DOCKING
MIKIO FUKASE, TSUGITO MARUYAMA, TAKASHI UCHIYAMA (Fujitsu Laboratories, Ltd., Mechatronics-in-Space Laboratory, Kawasaki, Japan), OSAMU OKAMOTO, and ISAO YAMAGUCHI (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 9 p.
(IAF PAPER 90-027) Copyright

This paper describes how to automatically estimate the distance and attitude of a target which are required to obtain for rendezvous and docking (RVD) by using visual sensing. When model features are extracted by using visual sensors, the main problems for visual sensors are poor lighting conditions and limited processing capacity in earth orbit. The present algorithm can be made robust under poor lighting conditions by using region data which can help its internal data cope with changing lighting conditions. It is also important for lightening the calculation load to decrease number of features for matching. The features selected are region-area and its relational arrangement. The distance and attitude of a target was estimated by using such simple data. When RVD-required data are actually obtained automatically by using this method, these features must be extracted automatically from an actual image. The extraction of these region data automatically from an actual image by band-pass binary, labeling, and interframe logical operation, was based on region-growing which lost few features under poor lighting conditions. Author

A91-13750#
AUTONOMOUS SPACE ROBOT CONCEPT WITH LEARNING CAPABILITIES - LABORATORY DEMONSTRATION OF PEG-IN-HOLE BY BI-ARM
TORU TANABE (Tokyo, University, Japan) and SHOJI YOSHIKAWA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p. refs
(IAF PAPER 90-028) Copyright

To realize some parts of human superiority and to overcome some difficulties of the present autonomous space robot control system design philosophy, a new concept of autonomous 'learning-type' space robot control system design philosophy is presented. In this concept the system is capable of learning necessary information for the given task through numerous input-output data in either on-line or off-line mode. To check the concept a classical peg-in-hole by bi-arm is chosen for laboratory experiments which indicate the concept is realizable. Experimental results show that the system can learn the operation of 'peg-in-hole' and also tolerate uncertainties and unknowns in the system. Author

A91-13751
AUTOMATION AND ROBOTICS IMPLEMENTATION FOR COLUMBUS FREE FLYING LABORATORY
E. SCHMIDT, P. FOTH, C. MASSAU, and A. KELLNER (MBB-ERNO, Bremen, Federal Republic of Germany) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 9 p.
(IAF PAPER 90-030)

An overview is given of the automation and robotics baseline concept for the Columbus Free Flying Laboratory. The central robot system, on-board robotic mission management, failure detection, failure isolation, and recovery from failure, and payload internal automation are addressed. An implementation approach for the baseline concept is presented, including a first development plan. C.D.

A91-13769#
CNES RENDEZ-VOUS AND DOCKING ACTIVITY...WITH A VIEW TO HERMES
PH. MARCHAL (CNES, Toulouse, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p. refs
(IAF PAPER 90-057) Copyright

An overview is presented of the achievements of CNES rendezvous and docking research performed over the past five years, with an emphasis on the implications for the Hermes program. Candidate sensor technologies, ground-based mockup systems for docking, and expert systems are examined. Baseline scenarios and strategies are outlined. C.D.

A91-13780*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION FREEDOM PRESSURIZED ELEMENT INTERIOR DESIGN PROCESS
GEORGE D. HOPSON (NASA, Marshall Space Flight Center, Huntsville, AL), JOHN AARON (NASA, Johnson Space Center, Houston, TX), and RICHARD L. GRANT (Boeing Aerospace and Electronics, Huntsville, AL) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 29 p. Previously announced in STAR as N90-28597.
(IAF PAPER 90-071)

The process used to develop the on-orbit working and living environment of the Space Station Freedom has some very unique constraints and conditions to satisfy. The goal is to provide maximum efficiency and utilization of the available space, in on-orbit, zero G conditions that establishes a comfortable, productive, and safe working environment for the crew. The Space Station Freedom on-orbit living and working space can be divided into support for three major functions: (1) operations, maintenance, and management of the station; (2) conduct of experiments, both directly in the laboratories and remotely for experiments outside the pressurized environment; and (3) crew related functions for food preparation, housekeeping, storage, personal hygiene, health maintenance, zero G environment conditioning, and individual privacy, and rest. The process used to implement these functions, the major requirements driving the design, unique considerations and constraints that influence the design, and summaries of the analysis performed to establish the current configurations are described. Sketches and pictures showing the layout and internal arrangement of the Nodes, U.S. Laboratory and Habitation modules identify the current design relationships of the common and unique station housekeeping subsystems. The crew facilities, work stations, food preparation and eating areas (galley and wardroom), and exercise/health maintenance configurations, waste management and personal hygiene area configuration are shown. U.S. Laboratory experiment facilities and maintenance work areas planned to support the wide variety and mixtures of life science and materials processing payloads are described. Author

A91-13783#
AUTONOMOUS EVA SUPPORT COMPLEX DESIGNED FOR USAGE DURING SPACE STATION ASSEMBLY AND MAINTENANCE - METHODS TO INCREASE THE COMPLEX EFFECTIVENESS
G. I. SEVERIN, V. I. SVERTSHEK, I. P. ABRAMOV, and V. A. FROLOV (Zvezda, Tomilino, USSR) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p.
(IAF PAPER 90-075) Copyright

Results of flight development tests of the EVA unit and MMU during EVAs from the Mir orbiting station Kvant-2 module are presented. Needs which must be addressed in future development of the equipment are considered. The main characteristics of the EVA support facility are listed, and diagrams of the cosmonaut maneuvering unit are shown, along with a unit function diagram. C.D.

A91-13784*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE SPACE STATION FREEDOM FLIGHT TELEROBOTIC SERVICER - THE DESIGN AND EVOLUTION OF A DEXTEROUS SPACE ROBOT
HARRY G. MCCAIN, JAMES F. ANDARY, DENNIS R. HEWITT (NASA, Goddard Space Flight Center, Greenbelt, MD), and DENNIS C. HALEY (Martin Marietta Space Systems, Inc., Denver, CO) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p.
(IAF PAPER 90-076) Copyright

The Flight Telerobotic Servicer (FTS) will provide a telerobotic capability to the Space Station in the early assembly phases of the program and will be used for assembly, maintenance, and inspection throughout the lifetime of the Station. Here, the FTS design approach to the development of autonomous capabilities is discussed. The FTS telerobotic workstations for the Shuttle and Space Station, and facility for on-orbit storage are examined. The rationale of the FTS with regard to ease of operation, operational versatility, maintainability, safety, and control is discussed. C.D.

A91-13785#
JEMRMS OPERATIONAL PERFORMANCE VERIFICATION APPROACH
K. KURAOKA (NASDA, Tokyo, Japan), K. GOMA, Y. SHINOMIYA, and S. NISHIDA (Toshiba Corp., Kawasaki, Japan) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p.
(IAF PAPER 90-077) Copyright

The general performance verification concept which JEMRMS (Japanese Experiment Module Remote Manipulator System) will be subjected to during the design, development, test, and evaluation phases of the first Japanese space robotics arms is described. The JEMRMS operational scenario is reviewed, showing a summary of the operational modes. The verification approach is shown for the software and hardware functions, arm control performance, and task planning, operational procedure and training, payload handling, and human-machine interface aspects of operational function. The test bed is described, and tests to confirm the preprogrammed control mode of the main arm and to verify the concept of the main and small fine arm control capability are reviewed. C.D.

A91-13798#
OPERATIONS PROCEDURE PLANNING TOOLS FOR SPACE STATION ROBOTICS TASK ANALYSIS
DAVID G. COOKE (Spar Aerospace, Ltd., Advanced Technology Systems Group, Weston, Canada) and DAVID HUNTER (Canadian Space Agency, Ottawa, Canada) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 10 p.
(IAF PAPER 90-095) Copyright

An evolving methodology for the development, validation, and configuration control of manipulator procedures for the Mobile Servicing Center of the Space Station Freedom is described. The overall development concept and the development tools are described, and an Assisted Mission Planning System, which reduces the engineer's workload and provides rapid, error-free creation of Mobile Servicing System mission procedures is discussed. The procedure development cycle is illustrated by an Integrated Electronics Assembly On-Orbit Replacement Unit changeout, showing how the various tasks are completed in order. C.D.

A91-14014#
MULTIMISSION OPERATOR WORKSTATION IN OPERATION CENTERS
R. CASPAR and J. P. DENIER (Matra Espace, Toulouse, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(IAF PAPER 90-408) Copyright

The concept of the multimission operator workstation (MOW) developed in the framework of the Hermes Flight Control Center (HFCC) definition study is introduced and described. The MOW concept has been introduced to find common and unique means to be used for different mission of different projects. The definition of the MOW relies on: (1) a preliminary definition establishing the connections between the HFCC characteristics and the multimission concept; (2) a multidisciplinary approach for man-system interaction; and (3) a design methodology for man-machine interfaces. Current work being done in the framework of the in-orbit infrastructure ground segment is examined. B.J.

A91-14073#
THE DEVELOPMENT OF ADVANCED CENTRIFUGES FOR SPACE BIOLOGY EXPERIMENTS
G. TRAXLER and K. SPERKER (Oesterreichische Raumfahrt- und Systemtechnik Gesellschaft mbH, Vienna, Austria) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 5 p. Research supported by ESA.
(IAF PAPER 90-550) Copyright

Advanced centrifuges for space biology will render possible long term experiments with biological samples for determining gravity threshold effects as well as serving as 1 g reference experiments. The development of such systems is driven by the requirements for a very low microgravity disturbance and for providing a maximal experimental area being exposed to a gravity field with the least possible gradient. Design concepts are presented for large diameter centrifuges, comprising also tethered systems, as well as for a 650 mm diameter centrifuge with a capability for automatic sample transfer from and onto a spinning rotor, respectively. A breadboard model of the latter one has been developed and is being used for the demonstration and verification of the design in critical technology areas. Author

A91-14138#
USING BISENSORY FEEDBACK DISPLAYS FOR SPACE TELEOPERATION
M. J. MASSIMINO (MIT, Cambridge, MA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. refs
(IAF PAPER ST-90-005) Copyright

This paper investigates the use of tactile and auditory displays to present feedback to the pilot of a spacecraft or the operator of a space teleoperated system. Force feedback is given particular attention for teleoperator scenarios in the presence of a time delay. The motivation for and potential benefits of developing bisensory feedback displays are identified. Pioneering research in developing auditory and tactile displays is discussed. Several models of the human operator concerning the processing of bisensory information are outlined, along with a discussion of presenting redundant information across sensory modalities. Preliminary experimental results concerning sensory substitution of force feedback with a vibrotactile display are presented along with future research plans. Author

A91-14177#
CREW WORKLOAD DURING INTERNAL SERVICING OF THE COLUMBUS FREE-FLYER BY HERMES
F. WINISDOERFFER and P. BERTHE (Aerospatiale, Division Systemes Strategiques et Spatiaux, Les Mureaux, France) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 11 p.
(IAF PAPER 90-541) Copyright

This paper presents a first attempt to address the problem of verifying the adequacy of the pressurized volumes of Hermes with the presence of man on-board. A brief description of the Stage 0 Configuration is presented. Then the various means of simulation are described and assessed for their apparent validity. A full-scale mock-up of the pressurized volumes has been built to verify the feasibility of the operations. But the complex operational setting required to assess the workload was not achieved in a satisfactory manner. The demonstration of the geometrical feasibility of the operations was achieved, data related to their duration was also produced, indicating that transfer operations in Hermes are foreseen to be less time consuming than the installation and check-out of the payload in Columbus. Author

A91-14237*# California Univ., Davis.
HUMAN FACTORS IN SPACECRAFT DESIGN
ALBERT A. HARRISON (California, University, Davis) and MARY M. CONNORS (NASA, Ames Research Center, Moffett Field, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 27, Sept.-Oct. 1990, p. 478-481. refs
Copyright

This paper describes some of the salient implications of evolving mission parameters for spacecraft design. Among the requirements for future spacecraft are new, higher standards of living, increased support of human productivity, and greater accommodation of physical and cultural variability. Design issues include volumetric allowances, architecture and layouts, closed life support systems, health maintenance systems, recreational facilities, automation, privacy, and decor. An understanding of behavioral responses to design elements is a precondition for critical design decisions. Human factors research results must be taken into account early in the course of the design process. Author

A91-14726* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LUNAR BASE AGRICULTURE: SOILS FOR PLANT GROWTH
DOUGLAS W. MING, ED. and DONALD L. HENNINGER, ED. (NASA, Johnson Space Center, Houston, TX) Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, 274 p. For individual items see A91-14727 to A91-14744.
Copyright

This work provides information on research and experimentation concerning various aspects of food production in space and particularly on the moon. Options for human settlement of the moon and Mars and strategies for a lunar base are discussed. The lunar environment, including the mineralogical and chemical properties of lunar regolith are investigated and chemical and physical considerations for a lunar-derived soil are considered. It is noted that biological considerations for such a soil include controlled-environment crop production, both hydroponic and lunar regolith-based; microorganisms and the growth of higher plants in lunar-derived soils; and the role of microbes to condition lunar regolith for plant cultivation. Current research in the controlled ecological life support system (CELSS) project is presented in detail and future research areas, such as the growth of higher research plants in CELSS are considered. Optimum plant and microbiological considerations for lunar derived soils are examined. L.K.S.

A91-14732
NUTRIENT AVAILABILITY AND ELEMENT TOXICITY IN LUNAR-DERIVED SOILS
L. R. HOSSNER and E. R. ALLEN (Texas A & M University, College Station) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 85-92. refs
Copyright

Possibilities of lunar soil as a growth medium for higher plant life are discussed. Availability of nutrients and problems deriving from toxicity of elements that may arise due to the chemical properties of lunar regolith are examined. Nutrients normally required by higher plants and the micronutrients which can be toxic in high concentrations are listed and compared to nutrient's available in lunar soil. Tables are provided listing the average elemental composition of lunar and terrestrial soils. It is suggested that, based on the composition and dissolution properties of lunar soil and dust, lunar regolith can potentially provide an adequate medium for growth of higher plants. Such growth would require exposure to an (enclosed) earth-like environment and additions of N, P, and K. It is noted that higher natural concentrations and potential dissolution of certain trace metals, particularly Cr and Ni, may prove toxic to plants and bacteria. L.K.S.

A91-14733* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MANUFACTURED SOILS FOR PLANT GROWTH AT A LUNAR BASE
DOUGLAS W. MING (NASA, Johnson Space Center, Houston, TX) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 93-105. refs
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Advantages and disadvantages of synthetic soils are discussed. It is pointed out that synthetic soils may provide the proper physical and chemical properties necessary to maximize plant growth, such as a toxic-free composition and cation exchange capacities. The importance of nutrient retention, aeration, moisture retention, and mechanical support as qualities for synthetic soils are stressed. Zeoponics, or the cultivation of plants in zeolite substrates that both contain essential plant-growth cations on their exchange sites and have minor amounts of mineral phases and/or anion-exchange resins that supply essential plant growth ions, is discussed. It is suggested that synthetic zeolites at lunar bases could provide adsorption media for separation of various gases, act as catalysts and as molecular seives, and serve as cation exchangers in sewage-effluent treatment, radioactive-waste disposal, and pollution control. A flow chart of a potential zeoponics system illustrates this process. L.K.S.

A91-14734* Utah State Univ., Logan.
CONTROLLED ENVIRONMENT CROP PRODUCTION - HYDROPONIC VS. LUNAR REGOLITH
BRUCE G. BUGBEE and FRANK B. SALISBURY (Utah State University, Logan) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 107-129. refs
(Contract NCC2-139)
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The potential of controlled environment crop production in a lunar colony is discussed. Findings on the effects of optimal root-zone and aerial environments derived as part of the NASA CELSS project at Utah State are presented. The concept of growing wheat in optimal environment is discussed. It is suggested that genetic engineering might produce the ideal wheat cultivar for CELSS (about 100 mm in height with fewer leaves). The Utah State University hydroponic system is outlined and diagrams of the system and plant container construction are provided. Ratio of plant mass to solution mass, minimum root-zone volume, maintenance, and pH control are discussed. A comparison of liquid hydrophonic systems and lunar regoliths as substrates for plant growth is provided. The physiological processes that are affected by the root-zone environment are discussed including carbon partitioning, nutrient availability, nutrient absorption zones,

root-zone oxygen, plant water potential, root-produced hormones, and rhizosphere pH control. L.K.S.

A91-14735
MICROORGANISMS AND THE GROWTH OF HIGHER PLANTS IN LUNAR-DERIVED SOILS
G. STOTZKY (New York University, NY) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 131-137. refs
(Contract EPA-CR-812484; EPA-CR-813431; EPA-CR-813650)
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The importance of microbes for colonization and exploitation of the lunar surface is discussed. Factors affecting the activity, ecology, and population dynamics of microorganisms in natural habitats and physiochemical factors of an environment that affect the toxicity of heavy metals and other pollutants to biological systems are listed. The importance of clay minerals to the growth of microbes and plants is discussed, noting that these minerals are primarily crystalline hydrous aluminosilicates and are essentially solid-state crystals that contain both negative (cation-exchange) and positive (anion-exchange) charges which are important in retaining nutrients in soil. It is suggested that zeolites, crystalline hydrous aluminosilicates, or clay minerals could be synthesized on the lunar surface by hydrothermal alteration of regolith components. The question of which microbes should be introduced into a lunar colony is addressed and potential contributions of genetically engineered microbes are discussed. L.K.S.

A91-14736
ROLE OF MICROBES TO CONDITION LUNAR REGOLITH FOR PLANT CULTIVATION
HENRY L. EHRLICH (Rensselaer Polytechnic Institute, Troy, NY) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 139-144. refs
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It is noted that, besides N, P, and S, plants require other mineral elements in trace amounts. Minerals that have been classified as either essential or growth stimulating are listed. The role of microbes in the mobilization of trace elements is discussed and a chart is provided which displays examples of microorganisms that can mobilize trace elements from minerals that are nutritionally important to plants. Charts are also provided of lunar minerals or rock that could supply essential elements to plants; elements that are nutritionally important to plants, but are not apparently available from lunar minerals or rocks; and microbial immobilization of solubilized elements of nutritional importance to plants. Relative reaction rates are also listed including the following processes: rockweathering, silicate attack, aluminosilicate attack, metal sulfide oxidation, iron oxidation, biosorption, bioprecipitation, and phosphate solubilization. L.K.S.

A91-14737* National Aeronautics and Space Administration, Washington, DC.
CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM
MAURICE M. AVERNER (NASA, Washington, DC) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 145-153. refs
Copyright

The NASA CELLS program is based upon the integration of biological and physiochemical processes in order to produce a system that will produce food, a breathable atmosphere, and potable water from metabolic and other wastes. The CELSS concept is described and a schematic system diagram is provided. Central to the CELSS concept is the Plant Growth Chamber, where green plant photosynthesis produces food, and aids in the production of oxygen and water. Progress to date at the Breadboard Facility at the Kennedy Space Center is summarized. The Breadboard Facility will implement the basic techniques and processes required for a CELSS based on photosynthetic plant growth in a ground-based system of practical size and results will be extrapolated to predict the performance of a full-sized system. Current available technology and near-future forecasts for plant growth techniques (focusing on maximum productivity), food sources (to select optimal CELSS plants), and waste management and contaminant control are discussed. L.K.S.

A91-14738* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CELSS BREADBOARD PROJECT AT THE KENNEDY SPACE CENTER
R. P. PRINCE and W. M. KNOTT, III (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 155-163. refs
Copyright

The CELSS Breadboard Project is described, noting that it was initiated to study aspects of a CELSS for long-term space missions. Topics for extensive investigation included air and water regeneration, engineering control, and food production. The many options available for growing food crops in commercial plant growth chambers were investigated and the best of this information was translated to the Biomass Production Chamber (BPC). The chamber contains 20 sq m of crop growing area under 96 400 W HPS lamps; sixteen 0.25 sq m plant growth trays used on each of four growing shelves for a total of 64 trays; and one 256-L nutrient solution reservoir with the appropriate continuous-flow, thin-film plumbing for each shelf. A heating, ventilating, and air-conditioning system maintains atmospheric conditions and serves to distribute oxygen and carbon dioxide and maintain pressure at 12 mm of water. The control and monitoring subsystem, which uses a programmable logic controller, manages the BPC subsystems. L.K.S.

A91-14739* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE CELSS RESEARCH PROGRAM - A BRIEF REVIEW OF RECENT ACTIVITIES
R. D. MACELROY, J. TREMOR, D. L. BUBENHEIM (NASA, Ames Research Center, Moffett Field, CA), and J. GALE (Jerusalem, Hebrew University, Israel) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 165-172. refs
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The history of the Controlled Ecological Life Support System program, initiated by NASA in the late 1970s to explore the use of bioregenerative methods of life support, is reviewed. The project focused on examining the process involved in converting inorganic minerals and gases into life support materials using sunlight as the primary energy source. The research, planning, and technological development required by the CELSS program and conducted at NASA field centers, at various universities, and by commercial organizations are reviewed. Research activities at universities have focused upon exploring methods of reducing the size of the system, reducing system power requirements, understanding issues that are associated with its long-term stability, and identifying new technologies that might be useful in improving its efficiency. Research activities at Ames research center have focused on the use of common duckweed as a high biomass-producing plant, which is high in protein and on waste processing. L.K.S.

A91-14740* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LIFE SUPPORT SYSTEMS RESEARCH AT THE JOHNSON SPACE CENTER
D. L. HENNINGER (NASA, Johnson Space Center, Houston, TX) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of

America, Inc., and Soil Science Society of America, Inc., 1989, p. 173-192. refs
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The bioregenerative life support systems research at Johnson Space Center focuses on the use of lunar regolith as a plant growth medium. Current dissolution experiments are being conducted to ascertain the response of lunar regolith to various solvents and weathering environments. The transformation of lunar minerals into minerals such as zeolites which would be more conducive to plant growth is also investigated. A study is currently underway to examine the ability of zeolite/apatite mixtures to provide N, P, and K through dissolution and ion exchange. The development and characterization of simulated lunar regolith for preliminary experimentation are also discussed. The life support systems technology used on the Mercury, Gemini, Apollo, and Shuttle missions is reviewed and current research on regenerative life support systems technology for potential use in Space Station Freedom is discussed. L.K.S.

A91-14741
PHYSICAL AND CHEMICAL CONSIDERATIONS FOR THE DEVELOPMENT OF LUNAR-DERIVED SOILS
P. A. HELMKE and R. B. COREY (Wisconsin, University, Madison) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 193-212. refs
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The physical and chemical needs that a plant-growing system must provide are outlined ways in which lunar regolith might be used in providing those needs are examined. The functions of rooting media are discussed including types of rooting media and nutrient delivery systems and plant growth media from lunar soil. The physical properties of lunar regolith are dicussed such as size and texture. Elements considered as nutrients essential for plant growth, their bioavailable forms, and the approximate ranges of concentrations of the major nutrients in the soil solution are given and ionic strength and pH of soil are discussed as significant factors affecting plant growth. The importance of various nutrient elements, their presence or absence in lunar soil, and possibilities for maintenance of optimum amounts are considered for the elements K, Ca, P, Mg, S, Cl, Mn, Fe, B, Mo, Zn, Cu, C, and N. L.K.S.

A91-14742
GEOCHEMISTRY OF SOILS FOR LUNAR BASE AGRICULTURE - FUTURE RESEARCH NEEDS
GENE WHITNEY (USGS, Denver, CO) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 213-235. refs
Copyright

Various geochemical research topics that require investigation to develop soils for controlled ecological life support systems (CELSS) on the moon are outlined. It is noted that a list of important geochemical processes to be considered would include the dissolution of primary minerals and glass; the precipitation of colloids and secondary minerals; cation, anion, and ligand absorption and exchange; redox exchange and control; and metal translocation and partitioning. These processes are reviewed in detail. Critical characteristics of lunar materials are reviewed including mineralogical and lithological characteristics, chemical characteristics, and physical and textural characteristics. A strategy for research on the geochemical process is presented. L.K.S.

A91-14743
PLANT CONSIDERATIONS FOR LUNAR BASE AGRICULTURE
T. W. TIBBITTS (Wisconsin, University, Madison) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 237-243. refs
Copyright

Research needs addressing the question of plant considerations for lunar based agriculture are divided into four general categories. Plant productivity is investigated. It is noted that the determination of the range of plant response to varying levels of all controllable environmental parameters can facilitate calculation of the most cost effective environments in different types of bases requiring life support. It is reccommended that response data obtained from plants should include the yield of edible product, portion of nonedible biomass, proportion and nutritional quality of the edible biomass that is digestible, the size of plants, and the amount of water transpired. Worldwide germplasm screening, plant breeding, toxic components, plant removal of contaminants, and waste recycling in the context of a closed environment are discussed. Automation and robotics are discussed as well as productivity, nutrient movement, plant orientation, plant support, and atmospheric composition and pressure in the space environment. L.K.S.

A91-14744
MICROBIOLOGICAL CONSIDERATIONS FOR LUNAR-DERIVED SOILS
D. B. ALEXANDER, D. A. ZUBERER (Texas A & M University, College Station), and D. H. HUBBELL (Florida, University, Gainesville) IN: Lunar base agriculture: Soils for plant growth. Madison, WI, American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989, p. 245-255. refs
Copyright

Various contributions that will be required of microorganisms to make possible the development of a soil that will support plant growth when introduced into the lunar environment are discussed. It is noted that microbial respiration produces CO2, which eventually forms carbonic acid, contributing to the disintegration of rocks and minerals into smaller parts. Microbes also play a role in the dissolution of primary minerals, the mobilization of elements, and the precipitation of secondary minerals. Carbon and nitrogen cycling in lunar-derived soils are diagrammed and nitrogen mineralization, nitrification, and denitrification are discussed. The process of dinitrogen fixation where prokaryotic microorganisms convert N2 into NH3, most of which is incorporated into microbial cells, is also examined. L.K.S.

A91-14745* Illinois Univ., Champaign.
MAPS OR ANALOGIES? A COMPARISON OF INSTRUCTIONAL AIDS FOR MENU NAVIGATION
JAYSON M. WEBB and ARTHUR F. KRAMER (Illinois, University, Champaign) Human Factors (ISSN 0018-7208), vol. 32, June 1990, p. 251-266. Research supported by NASA and IBM Corp. refs
Copyright

The relative efficacy of a variety of spatial maps and analogies as instructional aids for the learning and navigation of hierachical data bases is studied. Subjects performed single- and multinode retrieval tasks with novel data bases. The results of one experiment indicated that subjects who studied an analogy prior to performing data-retrieval tasks were less affected by increasing search distance than were subjects who studied a spatial map. The second experiment suggested that the benefits of analogy relative to other instructional aids increased as time passed between initial instruction and interaction with the data base. Author

A91-14858
EXPERIMENTAL STUDIES OF MANUAL OPTIMIZATION IN CONTROL TASKS
HIKARU INOOKA (Tohoku University, Sendai, Japan) and TATSUO KOITABASHI (Nagano Prefectural Institute of Industrial Technology, Japan) (IEEE, International Conference on Systems, Man, and Cybernetics, Cambridge, MA, Nov. 14-17, 1989) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 10, Aug. 1990, p. 20-23. refs
Copyright

The abilities of a human operator have been examined experimentally in a manual control task. In these experiments, a human operator was instructed to control the output of a plant so

as to minimize a performance index shown after each trial. The performance index, a combination of control effort and plant results, allows the operator to improve performance after repeated trials. The human operator can do the task satisfactorily after enough training even if there is no information about the plant dynamics or the form of the performance index. In addition, the operator develops distinct control action depending on the distinct characteristics of the performance index. Results are presented for both linear and nonlinear plants. The results indicate the high-level abilities of a human operator in controlling plants based on given performance indices. The high-level abilities include both learning and becoming an excellent controller. I.E.

A91-14978#
SHARED AUTONOMOUS AND TELEOPERATION ROBOTICS
WEIJIA ZHOU and NEIL A. DUFFIE (Wisconsin, University, Madison) AIAA and NASA, International Symposium on Space Information Systems, 2nd, Pasadena, CA, Sept. 17-19, 1990. 6 p. refs
(AIAA PAPER 90-5058) Copyright

This paper describes a shared telerobotic control concept and architecture developed at the Wisconsin Center for Space Automation and Robotics (WCSAR). The shared telerobotic system can accept and execute commands from both a six-degree-of-freedom master teleoperator controller and an autonomous controller. These inputs can be combined to provide both traded and shared control capabilities. A demonstration of the concept is described in which industrial robot manipulator was controlled in teleoperator, autonomous and shared modes.
Author

A91-16281#
THE APPLICATION OF PILOT RATING AND EVALUATION DATA FOR FLY-BY-WIRE FLIGHT CONTROL SYSTEM DESIGN
RANDALL E. BAILEY (Arvin/Calspan Advanced Technology Center, Buffalo, NY) AIAA, Atmospheric Flight Mechanics Conference, 8th, Portland, OR, Aug. 20-22, 1990. 13 p. refs
(AIAA PAPER 90-2826) Copyright

A pilot-vehicle dynamic system and a flying qualities design process are outlined, and the key metric in the flying qualities evaluations - the Cooper-Harper pilot rating, is described, with emphasis placed on evaluation pilot selection, evaluation tasks, and task-performance criteria. The most important aspects of the interpretation and application of the data, including understanding the rating data and the attendant pilot comments and interpreting the data with respect to the pilot-vehicle dynamic system are assessed, and it is noted that the pilot rating methodology and background material established by Cooper-Harper is tailored to minimize pilot-rating dispersion, and that the decision-tree rating process and precise wording and definitions in the scale are intended for that purpose. It is suggested that ground and in-flight simulations should be blended in the development of a new aircraft control-system design to ensure that the potential of fly-by-wire qualities is reached. V.T.

A91-16418
LASER SAFETY, EYESAFE LASER SYSTEMS, AND LASER EYE PROTECTION; PROCEEDINGS OF THE MEETING, LOS ANGELES, CA, JAN. 16, 17, 1990
PENELOPE K. GALOFF, ED. and DAVID H. SLINEY, ED. (U.S. Army, Environmental Hygiene Agency, Aberdeen Proving Ground, MD) Meeting sponsored by SPIE. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 1207), 1990, 248 p. No individual items are abstracted in this volume.
(SPIE-1207) Copyright

Various papers on laser safety, eyesafe laser systems, and laser eye protection are presented. Topics concerning retinal and corneal effects of eye damage mechanisms are addressed, including: deriving exposure limits, laser exposure effects on visual functions, model for predicting the effects of laser exposures and eye protection in vision, laser eye protection, UV laser effects on the cornea, corneal effects produced by IR laser radiation, small-spot laser exposure effects on visual function, and argon-laser-induced damage in the goldfish retina following whole-body hyperthermia. Also discussed are: eyesafe laser cloud mapper, status report on the U.S. Army's eyesafe laser rangefinder program MELIOS, 20-Hz eyesafe laser rangefinder for air defense, eyesafe CO2 laser rangefinder. Also discussed are: international laser safety regulations, eyesafe Raman lasers developed in West Germany, development of 1.54 micron near-IR Q-switched laser, GaAs eyesafe laser rangefinder, corneal reliability of excimer laser excision, modeling saturable absorption using 3-D spreadsheets, saturable absorbers for laser eye protection, saturation in commercial laser goggles, progress in tristimulus laser goggles, angle of incidence effect on multiline rugate filters, collimating lens system for laser eye protection, nonlinear holography approach for creating near-IR narrow notch reflectors. C.D.

A91-16683#
DYNAMIC SEAT CUING WITH WIDE VERSUS NARROW FIELD-OF-VIEW VISUAL DISPLAYS
GRANT R. MCMILLAN (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), JEFFREY D. CRESS, and MATTHEW S. MIDDENDORF (Logicon Technical Services, Inc., Dayton, OH) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1990, p. 53-62. refs
(AIAA PAPER 90-3128)

Experiments are performed to evaluate the combined effects of dynamic seat (g-seat) cuing and display field-of-view on the performance of a heading and altitude control task. Studies have demonstrated that g-seats can provide highly effective roll and pitch cues for turbulence-regulation flight control tasks. It is shown that g-seat cuing significantly improved subject performance with narrow (21 by 28 deg) and wide (60 by 83 deg) field-of-view displays. However, in both studies performance was better with the limited field-of-view displays. R.E.P.

A91-16684#
TIME DELAY COMPENSATION USING PERIPHERAL VISUAL CUES IN AN AIRCRAFT SIMULATOR
STEVEN L. LUSK (Logicon Technical Services, Inc., Dayton, OH), CYNTHIA D. MARTIN (Dayton, University, OH), JAMES D. WHITELEY (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), and WILLIAM V. JOHNSON (Systems Research Laboratories, Inc., Dayton, OH) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1990, p. 63-70. refs
(AIAA PAPER 90-3129)

The effects of simulator time delays on performance, control behavior and transfer of training are investigated utilizing supplementary peripheral visual cuing. A disturbance-regulation task was employed in which subjects were instructed to maintain a specific altitude and heading in the presence of pseudorandom wind gusts. This experiment was performed in a fixed-base simulator with fighter-type dynamics. It is concluded that supplementary peripheral cuing, mismatched or matched, was not able to sufficiently compensate for the unresponsiveness of the simulated aircraft. R.E.P.

A91-16690#
ADVANCED TECHNIQUES FOR CUING THE FORCE AND MOTION ENVIRONMENT IN THE SIMULATOR OF THE FUTURE
YORKE J. BROWN (Cardullo, Brown and Associates, Binghamton, NY), FRANK M. CARDULLO (New York, State University, Binghamton), and GRANT R. MCMILLAN (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Dayton, OH, Sept. 17-19, 1990, Technical Papers. Washington, DC, American Institute of Aeronautics and

Astronautics, 1990, p. 115-122. refs
(AIAA PAPER 90-3135)

A recent study which explored the psychophysiological mechanisms of motion perception and a variety of methods for creating a synthetic aeronautical force and motion environment is reviewed. Techniques such as lower body negative pressure, thermal cutaneous cue enhancement, peripheral vision occultation, direct head, limb, and equipment loading, vibromyesthetic illusions, and electroneural and electromuscular stimulation were investigated. The Armstrong Aerospace Medical Research Laboratory study shows that the simulator of the future will perform much better than current equipment in the high-G and sustained-G portions of the flight envelope, and that the force and motion environment of more normal maneuvers in flight will also be synthesized with greater efficiency. R.E.P.

N91-12205# Oak Ridge National Lab., TN. Cognitive Systems and Human Factors Group.
THE PART TASK TRAINER FOR AIRBORNE WEAPONS SYSTEMS: HUMAN FACTORS EVALUATION OF THE USER INTERFACE
MICHELE TERRANOVA and DIANE E. HARTLEY (Tennessee Univ., Knoxville.) Sep. 1990 66 p
(Contract DE-AC05-84OR-21400; DOE-1714-1714-A1)
(DE90-017772; ORNL/TM-11635) Avail: NTIS HC/MF A04

This research examined and evaluated the human factors aspects of a part-task trainer's user interface. Questionnaires, interviews, and observational techniques were used. A number of established human factors attributes were investigated such as user control and trainer fidelity. Recommendations are given for a variety of issues such as screen design (e.g., design log-on process and procedures for user identification to be as simple as possible); text display (e.g., avoid sentences exceeding 20 words); and training for cognitive skills (e.g., train time sharing skills for dealing with high workload environments). The results and recommendations for future enhancements are reported. An installation process was documented and comments regarding its effectiveness are included. DOE

N91-12206# Anacapa Sciences, Inc., Fort Rucker, AL.
AN EXPERIMENTAL EVALUATION OF THE CUEING PROCEDURES USED WITH THE PILOT'S LINE-OF-SIGHT RETICLE Interim Report, Feb. 1987 - Dec. 1989
RICHARD D. WEETER and D. MICHAEL MCANULTY Jun. 1990 46 p
(Contract MDA903-87-C-0523)
(AD-A224935; ASI690-316-90; ARI-RN-90-28) Avail: NTIS HC/MF A03 CSCL 05/8

Three experiments were conducted to evaluate the cueing procedure for the copilot-gunner's (CPG) line-of-sight (LOS) symbol in the AH-64A pilot night vision system. The location of the CPG, or Cued, LOS is indicated by dots positioned on imaginary axes extending from the arms (0, 90, 180, 270 deg) of the pilot's LOS reticle. The procedure uses either one- two-dot cues to indicate one of eight search areas for locating the CPG LOS. The cueing dots also flash when the pilot must boresight the integrated helmet and display sight subsystem (IHADSS). The three experiments used a selective visual attention paradigm. Experiment 1 evaluated the effects of the number of cueing elements and the presentation duration on the accurate perception of the cues. Experiment 2 compared the effectiveness of the one-and two-dot cues in locating a fixed target. Experiment 2 also evaluated the effects of presentation duration and practice on target identification accuracy. Experiment 3 evaluated the effect of the secondary meaning (boresight required) on the accuracy of target identification under the dot, duration, and practice conditions. GRA

N91-12207# Air Force Human Resources Lab., Brooks AFB, TX. Logistics and Human Factors Div.
DESIGNING HUMAN-CENTERED SYSTEMS: CIRCA 2039 SCENARIO Interim Technical Report, Aug. 1988 - Apr. 1990
EUGENE H. HENRY Aug. 1990 13 p
(AD-A225075; AFHRL-TR-90-32) Avail: NTIS HC/MF A03 CSCL 12/5

The advancement of technology has permitted the introduction of automation into a variety of military environments. Though automation offers new and increased capabilities, issues exist concerning the operability of systems with automation. For example, what is the appropriate operator workload associated with using automated systems. To answer such questions, a new and broad methodology is required. The Air Force Human Resources Laboratory (AFHRL) is presently conducting research to develop such a methodology, called the Automation Impacts Research Testbed (AIRT). A futuristic vision of a mature AIRT is provided along with how it can assist the design of automated systems. In relating this vision, the report is written as a story set in the twenty-first century. The story illustrates the operability concept through characters who describe examples of good and bad operability designs. Additionally, the story includes a description of possible tools that might be used in the future to address operability concerns. The scenario ends by being linked to the research presently being conducted at AFHRL. GRA

N91-12208# Dynamics Research Corp., Wilmington, MA.
HARDWARE VERSUS MANPOWER COMPATIBILITY METHODOLOGY. VOLUME 1: OVERVIEW AND MANAGER'S GUIDE Final Report, Sep. 1986 - Mar. 1988
DAVID HERLIHY, JANE BONDARUK, GUY NICHOLAS, ROBERT GUPTILL, and JOHN PARK May 1990 163 p
(Contract MDA903-86-C-0298; DA PROJ. 2Q2-63007-A-793)
(AD-A225122; ARI-RP-90-19A-VOL-1) Avail: NTIS HC/MF A08 CSCL 05/9

The Army Hardware vs. Manpower (HARDMAN) Comparability Methodology (HCM) is a six-step process for determining a weapon system's manpower, personnel, and training (MPT) requirements. It provides a structured approach for early MPT estimation based on comparability analysis, an analytic system that uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems. The HCM's six interrelated steps are Systems Analysis, Manpower Requirements Analysis, Personnel Pipeline Analysis, Training Resource Requirements Analysis, Impact Analysis, and Tradeoff Analysis. The HCM has been successfully applied to a range of weapons systems, including air, armor, artillery, infantry, air defense, command and control, and intelligence systems. The Product Improvement Program for HCM made major revisions to the existing HCM Guide. The scope has been expanded to include several new areas; existing procedures have been revised, refined, and clarified; and the entire Guide has been rewritten to achieve greater clarity, consistency, and completeness. This volume addresses the planning and conducting of an HCM analysis. Procedures are provided for determining the analysis scope and estimating the resources required for the analysis. Preparation of the quality assurance plan and establishment of the consolidated database are explained. The relationship between HCM results and various Army MPT documents is also discussed. GRA

N91-12209# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
TEMPORAL ISSUES OF ANIMATE RESPONSE
A. A. M. KUIJK Dec. 1989 14 p
(CWI-CS-R8960; ETN-90-98093) Copyright Avail: NTIS HC/MF A03

Due to increased capacities of personal workstations, graphical user interfaces become capable of offering natural human computer interaction. This results in animate response, i.e., natural transitions from one state into another. It is recognized that for optimal efficiency, such animate response should be tuned to the time frame of the user. It is not sufficient to speed up the response as much as possible: the temporal characterisics of the response should be based on human perceptual capabilities. A survey of notions related to animate response is presented. Subjects which need consideration and/or further investigation are addressed throughout. ESA

N91-12685# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
PILOT MONITORING OF DISPLAY ENHANCEMENTS GENERATED FROM A DIGITAL DATA BASE
PETER J. BENNETT and JOHN J. COCKBURN *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems 7 p Apr. 1990
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A Ferranti International integrated covert mission system called PENETRATE (Passive Enhanced Navigation with Terrain Referenced Avionics) is currently undergoing flight trials on a Hunter fast-jet aircraft at the Royal Aerospace Establishment. The heart of the PENETRATE system is a digital data store housing a three dimensional model of the terrain including cultural details and tactical intelligence information. This integrated mass memory store supplies data to a Terrain Referenced Navigation System, a head-down digital map and a head-up Skeletal Perspective Terrain Image Generator. The integrity of the terrain data loaded into this covert system cannot be totally guaranteed; neither can the navigation accuracy. The pilot must, therefore, use his normal visual technique to monitor the synthetic terrain displays for acceptable correlation with the real world. The PENETRATE integrated covert mission system, the increase in operational capability it provides, and the visual monitoring requirements are described. Author

N91-12693# Royal Aircraft Establishment, Farnborough (England).
RESEARCH INTO A MISSION MANAGEMENT AID
J. R. CATFORD and I. D. GRAY (Ferranti Ltd., Chadderton, England) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems 10 p Apr. 1990
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Pilot workload in fighter aircraft is ever increasing, driven by the need to fly low and the complexity of the systems and weapons in modern aircraft. The density and growing sophistication of Warsaw Pact anti-aircraft weapon systems greatly exacerbate the problem. The current European trend towards single seat fighter aircraft, on grounds of system and manpower costs, increases the workload problem still further. The research project, is directed to put the crew back in charge by introducing new levels of weapon systems automation. The Mission Management Aid (MMA) is scheduled for clearance into service in the first decade of the next century and although it is confidently expected that the airborne computing power to perform the task will be available in that timescale, the complementary disciplines to design, test, and validate such a system needs to be developed. The current research program is concentrated on the timely development of these disciplines. The basic functional approach to the MMA was outlined some four years ago. Research into the MMA is being undertaken jointly by the four industrial organizations and the Royal Aerospace Establishment (RAE). The current program which was running for two years, involves seconded staff from the industrial organizations and the RAE, Farnborough where the team is located. It is very evident that current fighter aircraft systems are composed of a number of well tested evaluated and validated sub-systems and yet the integrated system tends to exhibit serious operational problems and a long time delay before modifications to clear these problems can be introduced. It is hence essential that the more complex systems of the next century exhibit characteristics that allow for rapid modification to meet changing operational needs and yet maintain essential operational integrity through these changes. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A91-14105#
REFLECTIONS ON THE MODERN HISTORY OF SETI
FRANK D. DRAKE (California, University, Santa Cruz; SETI Institute, Mountain View) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 2 p.
(IAF PAPER 90-574)

An overview is presented of the history of SETI and experiments that have been conducted to detect extraterrestrial intelligent transmissions. The idea that interstellar radio transmissions are plausible has been considered since the turn of the century. When radio astronomy developed and showed that there was a whole new universe of remarkable phenomena to be observed, life elsewhere did not appear strange at all, particularly when compared to phenomena as quasars and pulsars present in space. Calculations from various research projects were assisted by supporting data from laboratories that showed a multitude of chemical pathways by which life might develop on primitive planets, as well as by astronomical observations strongly suggesting that planetary systems are very common. The NASA sponsored SETI program will use a number of multichannel radio spectrum analyzers to search the entire sky for many years over a broad range of frequencies. R.E.P.

A91-14106# Harvard Univ., Cambridge, MA.
HIGH RESOLUTION SETI - EXPERIENCES AND PROSPECTS
PAUL HOROWITZ and KEN CLUBOK (Harvard University, Cambridge) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p. Research supported by the Planetary Society, NASA, Dudley Observatory, and Hofheinz Foundation.
(IAF PAPER 90-575) Copyright

The paper examines the question of the usefulness of narrowband search for extraterrestrial intelligence (SETI), how serious its limitations are, how to circumvent them, and in what direction SETI should evolve. A frequency-agile receiver with an FFT-based 8 megachannel digital spectrum analyzer, on-line signal recognition, and multithreshold archiving has been constructed. This receiver is used to conduct a meridian transit search of the northern sky at the Harvard-Smithsonian 26-meter antenna, with a second identical system to begin observations in Argentina. Attention is given to the importance of increasingly powerful signal processing hardware, combined with ever-higher memory densities, which permit the construction of compact and affordable gigachannel spectrum analyzers that cover hundreds of megahertz of instantaneous bandwidth. R.E.P.

A91-14107*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SETI PROTOTYPE SYSTEM FOR NASA'S SKY SURVEY MICROWAVE OBSERVING PROJECT - A PROGRESS REPORT
M. J. KLEIN, S. GULKIS, and H. C. WILCK (JPL, Pasadena, CA) IAF, International Astronautical Congress; 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 8 p.
(IAF PAPER 90-576)

Two complementary search strategies, a Targeted Search and a Sky Survey, are part of NASA's SETI microwave observing project scheduled to begin in October of 1992. The current progress in the development of hardware and software elements of the JPL Sky Survey data processing system are presented. While the Targeted Search stresses sensitivity allowing the detection of either continuous or pulsed signals over the 1-3 GHz frequency range, the Sky Survey gives up sensitivity to survey the 99 percent of the sky that is not covered by the Targeted Search. The Sky Survey spans a larger frequency range from 1-10 GHz. The two searches will deploy special-purpose digital signal processing

equipment designed and built to automate the observing and data processing activities. A two-million channel digital wideband spectrum analyzer and a signal processor system will serve as a prototype for the SETI Sky Survey processor. The design will permit future expansion to meet the SETI requirement that the processor concurrently search for left and right circularly polarized signals. R.E.P.

A91-14108#
THE MCSA 2.1 - A FULLY DIGITAL REAL-TIME SPECTRUM ANALYZER DEVELOPED FOR NASA'S SETI PROJECT
JEROME F. DULUK, JR., ADRIAN JEDAY, MIKE MASSING, CHIH-KANG CHEN, and HUY HGUYEN (Silicon Engines, Inc., Palo Alto, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 7 p. refs
(IAF PAPER 90-577)

The organization and signal processing algorithms of the Multi-Channel Spectrum Analyzer, the MCSA 2.1, which is being developed for NASA's SETI project, are described. An overview of the architecture is given, and the MCSA 2.1 implementation approach is reviewed. The hardware is described, presenting a block diagram. C.D.

A91-14109*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SUMMARY OF INTERFERENCE MEASUREMENTS AT SELECTED RADIO OBSERVATORIES
JILL C. TARTER (SETI Institute, Mountain View; California, University, Berkeley) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 6 p.
(Contract NCC2-36; NCC2-336)
(IAF PAPER 90-580) Copyright

Results are presented from a series of RF interference (RFI) observations conducted during 1989 and 1990 at selected radio astronomy observatories in order to choose a site for the SETI, where the local and orbital RFI would be as benign as possible for observations of weak electromagnetic signals. These observatories included the DSS13 at Goldstone (California), the Arecibo Observatory (Puerto Rico), the Algonquin Radio Observatory in Ottawa (Canada), the Ohio State University Radio Observatory in Columbus (Ohio), and the NRAO in Green Bank (West Virginia). The observations characterize the RFI environment at these sites from 1 to 10 GHz, using radio astronomy antennas, feeds, and receivers; SETI signal processors; and stand-alone equipment built specifically for this purpose. The results served as part of the basis for the selection (by the NASA SETI Microwave Observing Project) of NRAO as the site of choice for SETI observations. I.S.

A91-14110*# American Embassy, Paris (France).
A REPLY FROM EARTH? - A PROPOSED APPROACH TO DEVELOPING A MESSAGE FROM HUMANKIND TO EXTRATERRESTRIAL INTELLIGENCE AFTER WE DETECT THEM
MICHAEL MICHAUD (American Embassy, Paris, France), JOHN BILLINGHAM (NASA, Ames Research Center, Moffett Field, CA), and JILL TARTER (SETI Institute, Mountain View, CA) IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 2 p. refs
(IAF PAPER 90-591)

The question of the formulation of a proper response to the detection of an extraterrestrial civilization is considered. It is proposed that an international agreement or declaration of principles establishing procedures enabling international participation in the making of such decisions be developed and that the SETI Committee of the International Academy of Aeronautics, in cooperation with other interested bodies, draft an agreement or declaration of principles that would set up these procedures; and that the draft be presented to the United Nations for consideration through the Committee on Peaceful Uses of Outer Space. A suggested outline of the agreement or declaration is presented and proposes that a response to the detection of extraterrestrial intelligence should be on behalf of all humankind; that this decision should be made by an appropriately representative international body; and that the content of the reply should reflect an international consensus. L.K.S.

A91-14222* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMET DUST AS A SOURCE OF AMINO ACIDS AT THE CRETACEOUS/TERTIARY BOUNDARY
KEVIN ZAHNLE and DAVID GRINSPOON (NASA, Ames Research Center, Moffett Field, CA) Nature (ISSN 0028-0836), vol. 348, Nov. 8, 1990, p. 157-160. refs
Copyright

It is suggested here that the large amounts of apparently extraterrestrial amino acids detected recently in rocks at the K/T boundary at Stevns Klint, Denmark were actually deposited with the dust from a giant comet trapped in the inner solar system, a fragment of which comprised the K/T impactor. Amino acids or their precursors in the comet dust would have been swept up by the earth both before and after the impact, but any conveyed by the impactor itself would have been destroyed. The observed amino acid layers would thus have been deposited without an impact. C.D.

A91-14272
CARBON ISOTOPE COMPOSITION OF INDIVIDUAL AMINO ACIDS IN THE MURCHISON METEORITE
M. H. ENGEL, J. A. SILFER (Oklahoma, University, Norman), and S. A. MACKO (Virginia, University, Charlottesville) Nature (ISSN 0028-0836), vol. 348, Nov. 1, 1990, p. 47-49. Research supported by NSF. refs
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The C-13 contents of individual amino acids in the Murchison meteorite are reported. The amino acids are enriched in C-13, indicating an extraterrestrial origin. Alanine is not racemic, and the C-13 enrichment of its D- and L-enantiomers implies that the excess of the L-enantiomer is indigeneous rather than terrestrial contamination, suggesting that optically active materials were present in the early solar system before life began. C.D.

A91-16226
ISOTROPICALLY DETECTABLE INTERSTELLAR BEACONS
ROBERT H. GRAY (Gray Data, Chicago, IL) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 43, Dec. 1990, p. 531-536. refs
Copyright

Interstellar microwave beacons producing sufficiently strong fluxes (about 10 to the -20 W/sq m at 21 cm) at target stars could be found relatively quickly by omnidirectional or broadbeam searches. The source position could be recovered after an initial detection using Doppler and time-delay effects. Such fluxes could be produced at ranges of 100 to 1000 ly with technology and resources not vastly exceeding those today. Author

A91-16228
A SEARCH FOR LINEAR ALIGNMENTS OF GAMMA-RAY BURST SOURCES
MICHAEL J. HARRIS (S.M. Systems and Research Corp., Landover, MD) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 43, Dec. 1990, p. 551-555. refs
Copyright

Antimatter annihilation (electron-positron) spacecraft may mimic the behavior of cosmic gamma-ray burst sources. A search has been made for the linear alignments of bursts along the spacecraft trajectory which would result, using burst locations and spectra observed by the 1978-1980 Interplanetary Network of gamma-ray detectors. No suspicious alignments have been found. Author

A91-16229
THE SEARCH FOR COMPANIONS TO EPSILON ERIDANI
A. T. LAWTON and P. WRIGHT British Interplanetary Society, Journal (ISSN 0007-084X), vol. 43, Dec. 1990, p. 556-558. refs
Copyright

Epsilon Eridani (HD22049), regarded as a nearby sun-like star, has often been scrutinized as a possible SETI candidate. With Tau Ceti, it was one of the two stars selected for Drake's original Project Ozma, the pioneering attempt to search for alien radio signals. Different instruments which have examined Epsilon Eridani previously have yielded varying results, some of which are either in conflict or spurious. Author

A91-16231
A LANGUAGE BASED ON THE FUNDAMENTAL FACTS OF SCIENCE
C. L. DEVITO and R. T. OEHRLE (Arizona, University, Tucson) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 43, Dec. 1990, p. 561-568. Research supported by the U.S. Navy and Research Corp. refs
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The problem of how to communicate with the members of an alien society has been discussed by many authors but only one, Freudenthal, has constructed a language for this purpose. Freudenthal assumes nothing other than the ability to reason as humans do and, because he assumes so little, it is necessary to communicate a great deal about the language itself before being able to communicate any interesting information. The problem is here approached differently. Since it is likely that contact between the civilization and an alien one would be via radio, potential correspondents would have a basic knowledge of science. Such beings should therefore be able to learn a language based on fundamental science. It is assumed, more specifically, that the correspondents can count, understand chemical elements, are familiar with the melting and boiling behavior of a pure substance and understand the properties of the gaseous state. All this should be known to any society capable of developing the radio telescope. By systematically using this common knowledge one can communicate notation for numbers and chemical elements and then communicate the basic physical units; i.e., the gram, the calorie, the degree (Kelvin), etc. Once this is done more interesting information can be exchanged. Author

A91-16352* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EARTH ANALOGS FOR MARTIAN LIFE - MICROBES IN EVAPORITES, A NEW MODEL SYSTEM FOR LIFE ON MARS
LYNN J. ROTHSCHILD (NASA, Ames Research Center, Moffett Field, CA) Icarus (ISSN 0019-1035), vol. 88, Nov. 1990, p. 246-260. refs
Copyright

It is suggested that 'oases' in which life forms may persist on Mars could occur, by analogy with terrestrial cases, in (1) rocks, as known in endolithic microorganisms, (2) polar ice caps, as seen in snow and ice algae, and (3) volcanic regions, as witnessed in the chemoautotrophs which live in ocean-floor hydrothermal vents. Microorganisms, moreover, have been known to survive in salt crystals, and it has even been shown that organisms can metabolize while encrusted in evaporites. Evaporites which may occur on Mars would be able to attenuate UV light, while remaining more transparent to the 400-700 nm radiation useful in photosynthesis. Suggestions are made for the selection of Martian exobiological investigation sites. O.C.

A91-16568
SUMMARY AND IMPLICATIONS OF REPORTED AMINO ACID CONCENTRATIONS IN THE MURCHISON METEORITE
EVERETT L. SHOCK and MITCHELL D. SCHULTE (Washington University, Saint Louis, MO) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 54, Nov. 1990, p. 3159-3173. refs
(Contract NSF EAR-88-03822)
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The relative abundances of the extractable amino acids in Murchison meteorite are evaluated using literature data on amino acid concentrations in Murchison-meteorite extracts. Results show that, although the absolute abundances of each amino acid are highly variable, the relative abundances are nearly constant for a majority of amino acids for which multiple measurements were reported. It is concluded that, if these relative abundances are truly representative, they are consistent with the concepts of organic-matter homogeneity in the meteorite, even though the organic matter is distributed heterogeneously. I.S.

A91-16581
GOODBY TO THE WARM LITTLE POND?
M. MITCHELL WALDROP Science (ISSN 0036-8075), vol. 250, Nov. 25, 1990, p. 1078-1080.
Copyright

In the decade since the late Luis Alvarez hypothesized a 10-km asteroid impact as the basis of the K-T boundary extinction 65 million years ago, much thought has been given by scientists to the effects of primordial bombardments on the earliest forms of life. Maher and Stevenson (1988) have coined the term 'impact frustration' for the repeated destruction of early life forms by such impacts. According to computer simulations, the primary effects of such impacts would have been the plume of vaporized rock and other impact debris; quickly spreading around the world, the plume would have enveloped the planet in a blanket of rock vapor of some 2000 K temperature, with a pressure of the order of 100 times greater than that of the current atmosphere. The postulation of an origin of life in deep-sea hot springs has accordingly become extremely attractive. O.C.

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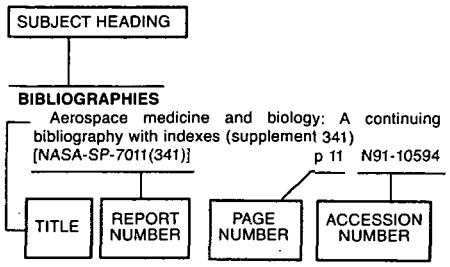

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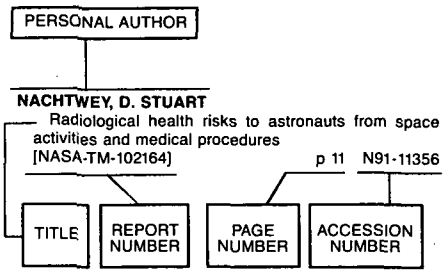

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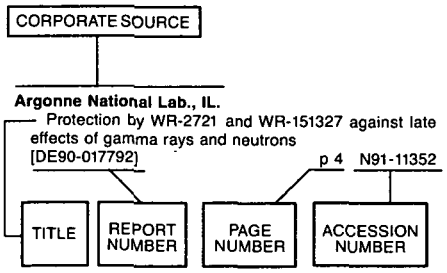

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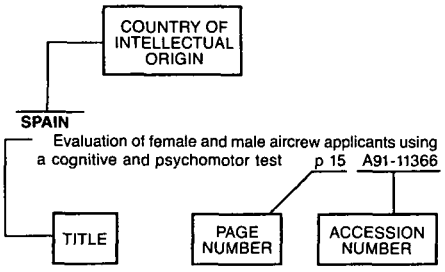

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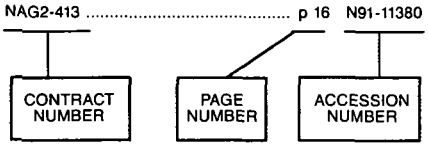

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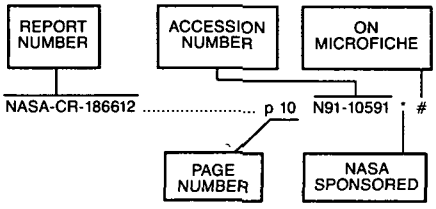

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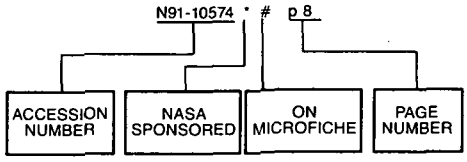

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NEVADA

UNIV. OF NEVADA-RENO LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
U.S. Documents Division
5 Washington Street
P.O. Box 630
Newark, NJ 07101
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
General Library
Government Publications/Maps Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-3826

NEW YORK

NEW YORK STATE LIBRARY
Documents Sect. Cultural Educ. Ctr.
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Davis Library 080A
BA/SS Department Documents
Chapel Hill, NC 27514
(919) 962-1151

NORTH DAKOTA

NORTH DAKOTA STATE UNIVERSITY LIBRARY
Government Documents Dept.
Fargo, ND 58105
(701) 237-8352
In cooperation with Univ. of North Dakota, Chester Fritz Library
Grand Forks

OHIO

STATE LIBRARY OF OHIO
Documents Section
65 South Front Street
Columbus, OH 43266
(614) 644-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-0489

OREGON

PORTLAND STATE UNIV.
Millar Library
934 SW Harrison - P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Publications Section
Box 1601
Walnut St. & Commonwealth Ave.
Harrisburg, PA 17105
(717) 787-3752

SOUTH CAROLINA

CLEMSON UNIV. COOPER LIB.
Documents Department
Clemson, SC 29634
(803) 656-5174
In cooperation with Univ. of South Carolina, Thomas Cooper Library, Columbia

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927 - 1201 Brazos
Austin, TX 78711
(512) 463-5455

TEXAS TECH. UNIV. LIBRARY
Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library & Learning Resources Center, UMC-30
Documents Department
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Library
Government Documents
Charlottesville, VA 22903
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Document Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Government Documents Section
P.O. Box 6069
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

ST. HIST SOC. OF WISCONSIN LIB.
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-2781
In cooperation with Univ. of Wisconsin-Madison, Memorial Library

MILWAUKEE PUBLIC LIBRARY
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3065

WYOMING

WYOMING STATE LIBRARY
Supreme Court & Library Bldg.
Cheyenne, WY 82002
(307) 777-5919

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