NASA SP-7011 (375)
May 1993

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

NASA STI PROGRAM
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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 212 reports, articles and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)	N93-17809 — N93-20540
International Aerospace Abstracts (A-10000 Series)	A93-21226 — A93-25710

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 1993 will be published in early 1994.

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

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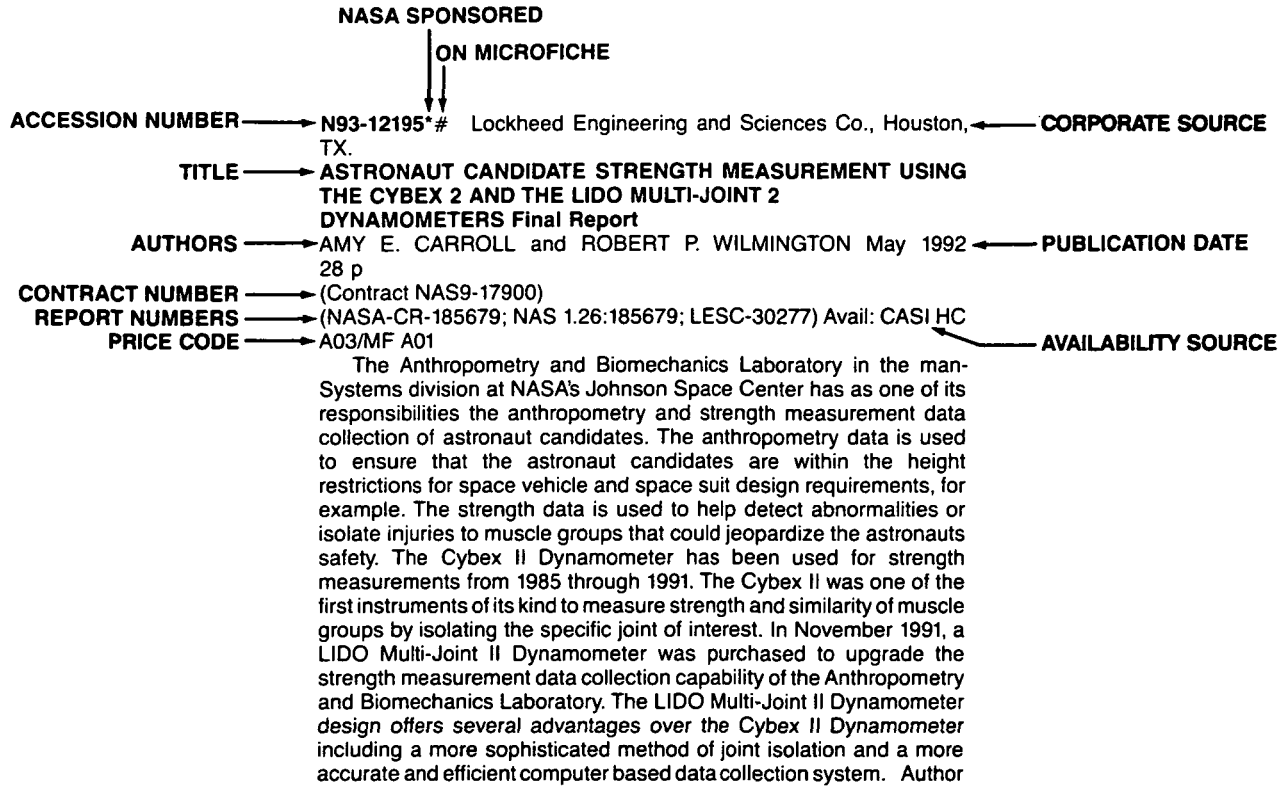
TYPICAL REPORT CITATION AND ABSTRACT



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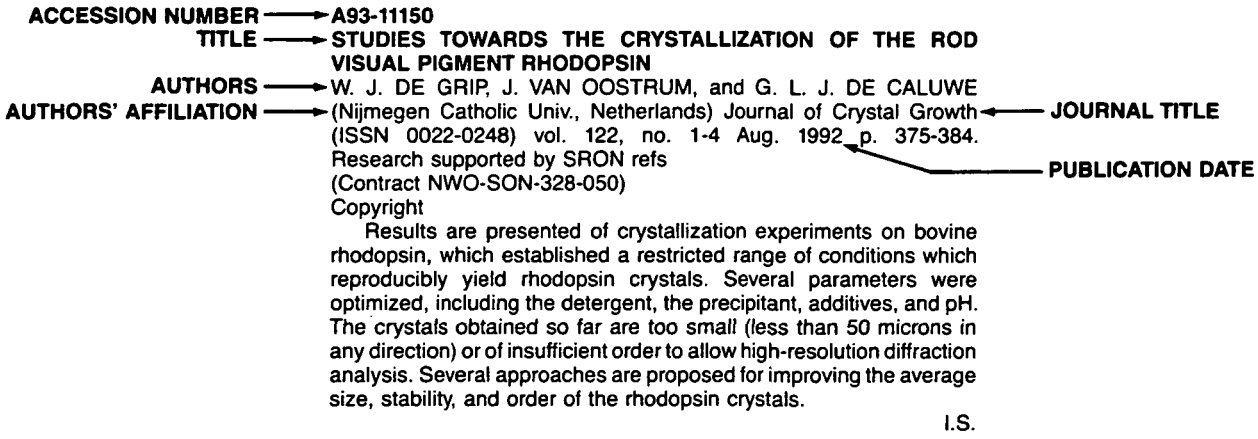

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 375)

May 1993

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LIFE SCIENCES (GENERAL)

A93-21684
INCREASED PLASMA O2 SOLUBILITY IMPROVES O2 UPTAKE OF IN SITU DOG MUSCLE WORKING MAXIMALLY
MICHAEL C. HOGAN, DAVID C. WILLFORD, PETER E. KEIPERT, N. S. FAITHFULL, and PETER D. WAGNER (California Univ., La Jolla; Alliance Pharmaceutical Corp., San Diego) Journal of Applied Physiology (ISSN 8750-7587) vol. 73, no. 6 Dec. 1992 p. 2470-2475. Research supported by Alliance Pharmaceutical Corp. refs
(Contract NIH-HL-17731)
Copyright

A perfluorocarbon emulsion was used to increase O2 solubility in the plasma compartment during hyperoxic low hemoglobin concentration perfusion of a maximally working dog muscle in situ. Data obtained show that the increased O2 solubility in the plasma compartment did not improve the capacity for diffusional conductance of O2 into the muscle. O.G.

A93-21901
SHORT-TERM MICROGRAVITY TO ISOLATE GRAVIPERCEPTION IN CELLS
HANS MACHEMER, RICHARD BRAEUCKER (Bochum, Ruhr-Univ., Germany), KEIICHI TAKAHASHI, and AKIRA MURAKAMI (Tokyo Univ., Japan) Microgravity Science and Technology (ISSN 0938-0108) vol. 5, no. 3 Dec. 1992 p. 119-123. Research supported by Science and Technology Agency of Japan refs
(Contract DARA-50-QV-8857-5)
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In the fall of 1991 a series of drop-tower experiments in ZARM (Bremen) was devoted to behavioral responses of unicellular organisms to step-type transition from normal gravity to microgravity. Modules for simultaneous 4-fold video-recording were incorporated into the flight capsule. In the course of 25 flights, 100 sets of experiments, each holding 100 to 200 cells, were flown under various conditions with a technical success rate of 94 percent and about 80 percent of the cells accessible to evaluation in the laboratory. A major goal of the experiments was the assessment of parameters of locomotion (velocity, orientation) in the absence of the gravity vector. The data show that in two species, Paramecium and Loxodes, the properties of steady-state micro-g-swimming correspond to horizontal swimming under 1 g-conditions. In a third species, Didinium, micro-g-swimming velocity exceeds 1 g-horizontal rates. The data are in agreement with an electrophysiological hypothesis of graviperception in cells.
Author

A93-22053
SELECTION OF A RIBOZYME THAT FUNCTIONS AS A SUPERIOR TEMPLATE IN A SELF-COPYING REACTION
RACHEL GREEN and JACK W. SZOSTAK (Massachusetts General Hospital, Boston) Science (ISSN 0036-8075) vol. 258, no. 5090 Dec. 18, 1992 p. 1910-1915. Research supported by Hoechst AG refs
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The sun Y ribozyme is derived from a self-splicing RNA group I intron. This ribozyme was chosen as a starting point for the design of a self-replicating RNA because of its small size. As a means of facilitating the self-replication process, the size of this ribozyme was decreased by the deletion of nonconserved structural domains; however, when such deletions were made, there was severe losses of enzymatic activity. In vitro genetic selection was used to identify mutations that reactivate a virtually inactive sun Y deletion mutant. A selected mutant with five substitution mutations scattered throughout the primary sequence showed greater catalytic activity than the original ribozyme under the selection conditions. The sun Y ribozyme and its small selected variant can both catalyze template-directed oligonucleotide assembly. The small size and reduced secondary structure of the selected variant results in an enhancement, relative to that of the original ribozyme, of its rate of self-copying. This engineered ribozyme is able to function effectively both as a catalyst and as a template in self-copying reactions. Author

A93-23074
DYNAMICS OF NORMALIZATION OF SOME BEHAVIORAL AND NEUROCHEMICAL DISTURBANCES IN RATS CAUSED BY THE DEPRIVATION OF THE PARADOXICAL SLEEP STAGE [DINAMIKA NORMALIZATSII NEKOTORYKH POVEDENCHESKIKH I NEIROKHIMICHESKIKH NARUSHENII, VYZVANNYKH U KRYS DEPRIVATSIEI PARADOKSAL'NOI FAZY SNA]
N. E. SOKOLOVA, N. P. TARANOVA, and I. N. KUDRIAVTSEVA (RAN, Inst. Fiziologii, St. Petersburg, Russia) Fiziologicheskii Zhurnal (ISSN 0015-329X) vol. 78, no. 5 May 1992 p. 9-16. In Russian. refs
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The effect of a selective deprivation of paradoxical sleep on orientational behavior and on cellular protein and nucleic acid metabolism in the Nucleus Raphe dorsalis (NRD) was investigated in rats subjected to 24-hr long deprivation of the paradoxical sleep stage, using the method of Jouvet et al. (1964). It was found that deprivation of paradoxical sleep led to an inhibition of the passive avoidance reaction (i.e., inhibition of memory and orientation ability in an open field). At the same time, the absolute amounts of proteins in neurons and gliacytes of the NRD was found to be less while the amounts of proteins and nucleic acids in the Locus ceruleus' cells was greater than in control rats. Restoration to normal behavior patterns and protein contents took place within 24-30 hours after the return of the animals to the normal sleep regimen. I.S.

A93-23075
STUDY OF THE FUNCTIONING OF THE CENTRAL AND THE PERIPHERAL CONTOURS OF THE THERMOREGULATION SYSTEM USING A THERMOPHYSICAL MODEL OF THE RABBIT BODY [ISSLEDOVANIE RABOTY TSENTRAL'NOGO I PERIFERICHESKOGO KONTURA SISTEMY TERMOREGULIATSII NA TEPLOFIZICHESKOI MODELI TELA KROLIKA]
G. V. RUMIANTSEV and G. B. MOROZOV (RAN, Inst. Fiziologii, St. Petersburg, Russia) Fiziologicheskii Zhurnal (ISSN

0015-329X) vol. 78, no. 5 May 1992 p. 93-99. In Russian. refs
Copyright

It has been shown that the regulation of heat balance in an animal body depends on the interaction between temperature signals from two heat-sensitive structures: the central and the peripheral structures. In this work, a thermal model of the rabbit body developed by Rumiantsev and Morosov (1988, 1989) was used to study the roles of the central and the peripheral heat-sensitive receptors in the maintenance of body temperature in response to stepwise heat stimuli. It was found that, in all cases of cooling and heating, the central network of temperature regulators maintained the temperature of the body model in the prescribed limits. The peripheral network did not respond at all to threshold changes of the body temperature caused by stepwise heat stimuli. I.S.

A93-23152
CHARACTERISTICS OF THE EFFECT OF INERT GASES ON IN VIVO TISSUE RESPIRATION [OSOBLIVOSTI VPLIVU INERTNIKH GAZIV NA TKANINNE DIKHANNIA IN VIVO]
T. M. GOVORUKHA and A. I. NAZARENKO (ANU, Inst. Fiziologii, Kiev, Ukraine) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489) vol. 38, no. 4 July-Aug. 1992 p. 86-88. In Ukrainian. refs
Copyright

The effect of breathing normoxic He-O2 or Ar-O2 mixtures on the level of tissue respiration was investigated in rats exposed for 1 hr to a He-O2 or an Ar-O2 atmosphere by measuring the rate of oxygen consumption by tissue homogenates prepared from livers of exposed animals. Results indicate that 1-hr-long exposure to either atmosphere led to an increased consumption of oxygen (as compared to air-breathing controls) by tissue homogenates. The effect was more pronounced in animals exposed to He-O2 mixtures than in those breathing Ar-O2. I.S.

A93-24047* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ANIMAL SURGERY IN MICROGRAVITY
MARK R. CAMPBELL (Clifton Medical and Surgical Clinic Association, TX), ROGER D. BILLICA (NASA, Johnson Space Center, Houston, TX), and SMITH L. JOHNSTON, III (Krug Life Sciences, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 58-62. Research supported by NASA and Krug Life Sciences refs
Copyright

Prototype hardware and procedures which could be applied to a surgical support system on SSF are realistically evaluated in microgravity using an animal model. Particular attention is given to the behavior of bleeding in a surgical scenario and techniques for hemostasis and fluid management. O.G.

A93-25651
INVESTIGATION OF THE CHARACTER OF CHANGES IN THE 'CENTRAL' TEMPERATURE OF THE BODY IN COLD ENVIRONMENT, USING A RABBIT-BODY THERMOREGULATION MODEL [ISSLEDOVANIE KHARAKTERA IZMENENII 'TSENTRAL'NOI' TEMPERATURY TELA PRI KHOLODOVYKH VOZDEISTVIIAKH NA MODELI TERMOREGULIATSII KROLIKA]
G. V. RUMIANTSEV (RAN, Inst. Fiziologii, St. Petersburg, Russia) Fiziologicheskii Zhurnal (ISSN 0015-329X) vol. 78, no. 7 July 1992 p. 97-103. In Russian. refs
Copyright

The rabbit-body thermoregulation model of Rumiantsev and Morozov (1988), equipped with a homeostasis-regulating system, was used to study the behavior of the model's 'central' thermoregulatory system when the ambient temperature in the thermochamber decreased from 22 C to 2 C. It was found that the value and the character of changes in the model's central temperature depended on the initial level of peripheral temperature and, in general, on the initial heat content of the model's body. In the case of a high level of the initial heat content, the temperature was found to drop at the start of the cooling period, whereas in the case of a low initial heat content, the temperature of the body's nucleus' increased. These results reproduce well changes of the rectal temperature observed in live rabbits subjected to cooling, provided a zone of insensitivity in the activity of the model's thermoregulatory system is assumed. I.S.

N93-18351* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REGENERABLE BIOCIDE DELIVERY UNIT Patent
RICHARD L. SAUER, inventor (to NASA) (Umpqua Research Co., Myrtle Creek, OR.), GERALD V. COLOMBO, inventor (to NASA), and CLIFFORD D. JOLLY, inventor (to NASA) (Umpqua Research Co., Myrtle Creek, OR.) 5 Jan. 1993 7 p Filed 18 Mar. 1991 Supersedes N91-25570 (29 - 17, p 2817)
(NASA-CASE-MSC-21763-1-SB; US-PATENT-5,176,836; US-PATENT-APPL-SN-671603; US-PATENT-CLASS-210-670; US-PATENT-CLASS-210-739; US-PATENT-CLASS-210-753; US-PATENT-CLASS-210-764; US-PATENT-CLASS-210-96.1; US-PATENT-CLASS-210-140; US-PATENT-CLASS-210-190)
Avail: US Patent and Trademark Office

A method and apparatus are disclosed for maintaining continuous, long-term microbial control in the water supply for potable, hygiene, and experimental water for space activities, as well as treatment of water supplies on Earth. The water purification is accomplished by introduction of molecular iodine into the water supply to impart a desired iodine residual. The water is passed through an iodinated anion exchange resin bed. The iodine is bound as I-(sub n) at the anion exchange sites and releases I(sub 2) into the water stream flowing through the bed. The concentration of I(sub 2) in the flowing water gradually decreases and, in the prior art, the ion-exchange bed has had to be replaced. In a preferred embodiment, a bed of iodine crystals is provided with connections for flowing water therethrough to produce a concentrated (substantially saturated) aqueous iodine solution which is passed through the iodinated resin bed to recharge the bed with bound iodine. The bed of iodine crystals is connected in parallel with the iodinated resin bed and is activated periodically (e.g., by timer, by measured flow of water, or by iodine residual level) to recharge the bed. Novelty resides in the capability of inexpensively and repeatedly regenerating the ion-exchange bed in situ. Official Gazette of the U.S. Patent and Trademark Office

N93-18545*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXOBIOLOGY IN SOLAR SYSTEM EXPLORATION
GLENN C. CARLE, ed., DEBORAH E. SCHWARTZ, ed., and JUDITH L. HUNTINGTON, ed. Aug. 1992 300 p Symposium held in Sunnyvale, CA, Aug. 1988; sponsored by the Exobiology Program of NASA's Division of Life Sciences Original contains color illustrations
(NASA-SP-512; NAS 1.21:512) Avail: CASI HC A13/MF A03; 46 functional color pages

A symposium, 'Exobiology in Solar System Exploration,' was held on 24-26 Aug. 1988. The symposium provided an in-depth investigation of the role of Exobiology in solar system exploration. It is expected that the symposium will provide direction for future participation of the Exobiology community in solar system exploration and alert the Planetary community to the continued importance of an Exobiology Flight Program. Although the focus of the symposium was primarily on Exobiology in solar system exploration missions, several ground based and Earth-orbital projects such as the Search for Extraterrestrial Intelligence, Gas Grain Facility, and Cosmic Dust Collection Facility represent upcoming research opportunities planned to accommodate the goals and objectives of the Exobiology community as well. This report contains papers for all but one of the presentations given at the symposium.

N93-18546*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OVERVIEW: EXOBIOLOGY IN SOLAR SYSTEM EXPLORATION
GLENN C. CARLE and DEBORAH E. SCHWARTZ *In its*

Exobiology in Solar System Exploration p 3-18 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

In Aug. 1988, the NASA Ames Research Center held a three-day symposium in Sunnyvale, California, to discuss the subject of exobiology in the context of exploration of the solar system. Leading authorities in exobiology presented invited papers and assisted in setting future goals. The goals they set were as follows: (1) review relevant knowledge learned from planetary exploration programs; (2) detail some of the information that is yet to be obtained; (3) describe future missions and how exobiologists, as well as other scientists, can participate; and (4) recommend specific ways exobiology questions can be addressed on future exploration missions. These goals are in agreement with those of the Solar System Exploration Committee (SSEC) of the NASA Advisory Council. Formed in 1980 to respond to the planetary exploration strategies set forth by the Space Science Board of the National Academy of Sciences' Committee on Planetary and Lunar Exploration (COMPLEX), the SSEC's main function is to review the entire planetary program. The committee formulated a long-term plan (within a constrained budget) that would ensure a vital, exciting, and scientifically valuable effort through the turn of the century. The SSEC's goals include the following: determining the origin, evolution, and present state of the solar system; understanding Earth through comparative planetology studies; and revealing the relationship between the chemical and physical evolution of the solar system and the appearance of life. The SSEC's goals are consistent with the over-arching goal of NASA's Exobiology Program, which provides the critical framework and support for basic research. The research is divided into the following four elements: (1) cosmic evolution of the biogenic compounds; (2) prebiotic evolution; (3) origin and early evolution of life; and (4) evolution of advanced life. Author

N93-18547*# Santa Clara Univ., CA. Dept. of Biology.
THE SOLAR SYSTEM: IMPORTANCE OF RESEARCH TO THE BIOLOGICAL SCIENCES
HAROLD P. KLEIN *In* NASA. Ames Research Center, Exobiology in Solar System Exploration p 19-28 Aug. 1992 Original contains color illustrations
Avail: CASI HC A02/MF A03; 46 functional color pages

An attempt is made to describe the scope of scientific areas that comprise the current field of exobiology in the United States. From investigations of astrophysical phenomena that deal with the birth of stars and planetary systems to questions of molecular biology involving phylogenetic relationships among organisms, from attempts to simulate the synthesis of biological precursor molecules in the chemistry laboratory to making measurements of the organic constituents of Titan's atmosphere, these researches all converge toward a common objective--answering the question of how life came about in the universe. Author

N93-18548*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE MOON: BIOGENIC ELEMENTS
EVERETT K. GIBSON, JR. and SHERWOOD CHANG (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) *In* NASA. Ames Research Center, Exobiology in Solar System Exploration p 29-44 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

The specific objectives of the organic chemical exploration of the Moon involve the search for molecules of possible biological or prebiological origin. Detailed knowledge of the amount, distribution, and exact structure of organic compounds present on the Moon is extremely important to our understanding of the origin and history of the Moon and to its relationship to the history of the Earth and solar system. Specifically, such knowledge is essential for determining whether life on the Moon exists, ever did exist, or could develop. In the absence of life or organic matter, it is still essential to determine the abundance, distribution, and origin of the biogenic elements (e.g., H, C, O, N, S, P) in order to understand how the planetary environment may have influenced the course of chemical evolution. The history and scope of this effort is presented. Author

N93-18549*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VENUS: A SEARCH FOR CLUES TO EARLY BIOLOGICAL POSSIBILITIES
LARRY COLIN and JAMES F. KASTING (Pennsylvania State Univ., University Park.) *In its* Exobiology in Solar System Exploration p 45-66 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

The extensive evidence that there is no extant life on Venus is summarized. The current atmospheric environment, which is far too hostile by terrestrial standards to support life, is described. However, exobiologists are interested in the possibility of extinct life on Venus. The early history of Venus is discussed in terms of its ability to sustain life that may now be extinct. Author

N93-18550*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MARS: A REASSESSMENT OF ITS INTEREST TO BIOLOGY
CHRISTOPHER P. MCKAY *In its* Exobiology in Solar System Exploration p 67-82 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

Of all the planets in the solar system, Mars is certainly the one that has inspired the most speculation concerning extraterrestrial life. Observers had long ago noticed that Mars exhibits changes in its polar caps and alterations in its surface coloration that parallel seasonal changes on Earth. The fascination with Mars and the possibility of life on Mars continued into the spacecraft era and was directly expressed in the Viking Missions. These highly successful missions had the search for life on Mars as one of their principal goals. A review of Viking Missions experiments is presented. Results of these investigations are summarized. While the Viking Missions returned a negative answer to the question of life on Mars, they also showed that many years ago Mars was a very different place and enjoyed conditions that may have been conducive to the origin of life - life that may have long since become extinct. Evidence for the existence of water on Mars in the past is presented. Techniques used to study early life on Earth, which may also be used for similar studies on Mars, are described. L.R.R.

N93-18551*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
GIANT PLANETS: CLUES ON CURRENT AND PAST ORGANIC CHEMISTRY IN THE OUTER SOLAR SYSTEM
JAMES B. POLLACK and SUSHIL K. ATREYA (Michigan Univ., Ann Arbor.) *In its* Exobiology in Solar System Exploration p 83-102 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

The giant planets of the outer solar system - Jupiter, Saturn, Uranus, and Neptune - were formed in the same flattened disk of gas and dust, the solar nebula, as the terrestrial planets were. Yet, the giant planets differ in some very fundamental ways from the terrestrial planets. Despite enormous differences, the giant planets are relevant to exobiology in general and the origin of life on the Earth in particular. The giant planets are described as they are today. Their basic properties and the chemistry occurring in their atmospheres is discussed. Theories of their origin are explored and aspects of these theories that may have relevance to exobiology and the origin of life on Earth are stressed. Author

N93-18552*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EUROPA: PROSPECTS FOR AN OCEAN AND EXOBIOLOGICAL IMPLICATIONS
JOHN ORO (Houston Univ., TX.), STEVEN W. SQUYRES (Cornell Univ., Ithaca, NY.), RAY T. REYNOLDS, and THOMAS M. MILLS (Houston Univ., TX.) *In its* Exobiology in Solar System Exploration

p 103-126 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

As far as we know, Earth is the only planet in our solar system that supports life. It is natural, therefore, that our understanding of life as a planetary phenomenon is based upon Earth-like planets. There are environments in the solar system where liquid water, commonly believed to be a prerequisite for biological activity, may exist in a distinctly non-Earth-like environment. One such location is Europa, one of the Galilean satellites of Jupiter. The possibility that liquid water exists on Europa presents us with some interesting exobiological implications concerning the potential of the satellite to support life. Topics include the following: an ocean on Europa; thermal evolution of Europa; Europa's three models; exobiological implications; early conditions of Europa; low-temperature abiotic chemistry; possibility of the emergence of life on Europa; prerequisites for the habitability of Europa; energy sources for biosynthesis and metabolic activity; habitability of Europa by anaerobic life; and habitability by aerobic life. Author

N93-18553*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TITAN
TOBIAS OWEN (Hawaii Univ., Honolulu.), DANIEL GAUTIER (Observatoire de Paris-Meudon, France), FRANCOIS RAULIN (Paris Univ., Creteil, France), and THOMAS SCATTERGOOD *In its* Exobiology in Solar System Exploration p 127-144 Aug. 1992 Original contains color illustrations
Avail: CASI HC A03/MF A03; 46 functional color pages

The following topics are discussed with respect to Titan: observations of the atmosphere; laboratory simulations and theoretical models of Titan's atmosphere; endpoints of atmospheric chemistry - aerosols and oceans; exobiology; and the next steps in understanding Titan. Author

N93-18561*# National Aeronautics and Space Administration, Washington, DC.
EXOBIOLOGY: THE NASA PROGRAM
JOHN D. RUMMEL, LYNN HARPER (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.), and DALE ANDERSEN (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) *In* NASA. Ames Research Center, Exobiology in Solar System Exploration p 263-272 Aug. 1992 Original contains color illustrations
Avail: CASI HC A02/MF A03; 46 functional color pages

The goal of NASA's Exobiology Program is to understand the origin, evolution, and distribution of life in the universe. To do this, the Exobiology Program seeks to provide a critical framework and some key research to allow NASA to bear the combined talents and capabilities of the agency and the scientific community, and the unique opportunities afforded by space exploration. To provide structure and direction to the quest for answers, the Exobiology Program has instituted a comprehensive research program divided into four elements which are being implemented at several of NASA's research centers and in the university community. These program elements correspond to the four major epochs in the evolution of living systems: (1) cosmic evolution of the biogenic compounds; (2) prebiotic evolution; (3) origin and early evolution of life; and (4) evolution of advanced life. The overall research program is designed to trace the pathways leading from the origin of the universe through the major epochs in the story of life. Author

N93-18608*# University City Science Center, Philadelphia, PA.
INVESTIGATION OF WHEAT COLEOPTILE RESPONSE TO PHOTOTROPIC STIMULATIONS Final Report, 1 Nov. 1989 - 31 Jan. 1993
DAVID G. HEATHCOTE, ALLEN H. BROWN, and DAVID K. CHAPMAN 31 Jan. 1993 34 p
(Contract NAG2-623)
(NASA-CR-192157; NAS 1.26:192157) Avail: CASI HC A03/MF A01

This report provides a summary of the preparations for, and the conduct and post-flight data analysis of, the Spacelab flight investigation FOTRAN, which flew on the IML-1 mission (STS-42) in January, 1992. The investigation was designed to provide data on the responses of wheat seedlings to various blue-light stimuli given while the plants were exposed to orbital microgravity conditions. Before the flight, a number of hypotheses were established which were to be tested by the data from the flight and parallel ground studies. A description of the experiment protocol developed for the mission is provided, and an account of the activities supported during preparations for and support of the flight experiment is given. Details of the methods used to reduce and analyze the data from the flight are outlined. Author

N93-19037*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HIGH DENSITY CELL CULTURE SYSTEM Patent Application
GLENN SPAULDING, inventor (to NASA) 23 Dec. 1992 15 p
(NASA-CASE-MSC-22060-1; NAS 1.71:MSC-22060-1;
US-PATENT-APPL-SN-996263) Avail: CASI HC A03/MF A01

An annular culture vessel for growing mammalian cells is constructed in a one piece integral and annular configuration with an open end which is closed by an endcap. The culture vessel is rotatable about a horizontal axis by use of conventional roller systems commonly used in culture laboratories. The end wall of the endcap has tapered access ports to frictionally and sealingly receive the ends of hypodermic syringes. The syringes permit the introduction of fresh nutrient and withdrawal of spent nutrients. The walls are made of conventional polymeric cell culture material and are subjected to neutron bombardment to form minute gas permeable perforations in the walls. NASA

N93-19054*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ACTIVE SYNTHETIC SOIL Patent Application
DOUGLAS W. MING, inventor (to NASA), DONALD L. HENNINGER, inventor (to NASA), EARL R. ALLEN, inventor (to NASA) (Oklahoma State Univ., Stillwater.), and DAGIGAMUWAGE C. GOLDEN, inventor (to NASA) (National Academy of Sciences - National Research Council, Houston, TX.) 16 Oct. 1992 26 p
(NASA-CASE-MSC-21954-1-NP; NAS 1.71:MSC-21954-1-NP;
US-PATENT-APPL-SN-963349) Avail: CASI HC A03/MF A01

A synthetic soil/fertilizer for horticultural application having all the agronutrients essential for plant growth is disclosed. The soil comprises a synthetic apatite fertilizer having sulfur, magnesium, and micronutrients dispersed in a calcium phosphate matrix, a zeolite cation exchange medium saturated with a charge of potassium and nitrogen cations, and an optional pH buffer. Moisture dissolves the apatite and mobilizes the nutrient elements from the apatite matrix and the zeolite charge sites. NASA

N93-19377*# University City Science Center, Philadelphia, PA. Gravitational Plant Physiology Lab.
A PROPOSAL TO DETERMINE PROPERTIES OF THE GRAVITROPIC RESPONSE OF PLANTS IN THE ABSENCE OF A COMPLICATING G-FORCE (GTHRES) Final Report
ALLAN H. BROWN, DAVID K. CHAPMAN (Pennsylvania Univ., Philadelphia.), DAVID G. HEATHCOTE, and ANDERS JOHNSSON (Trondheim Univ., Norway) 31 Jan. 1993 39 p
(Contract NAG2-574)
(NASA-CR-192219; NAS 1.26:192219) Avail: CASI HC A03/MF A01

Gravitropic responses of oat seedlings (Avena sativa L.) were measured on Earth and in microgravity (IML-1). The seedlings were grown at 1 g either on Earth or on 1 g centrifuges. They were challenged by centripetal accelerations for which the intensity and duration of the stimulations were varied. All stimulation intensities were in the hypogravity region from 0.1 to 1.0 g. All responses occurred either in Spacelab microgravity or during clinorotation on Earth. The experiments were carried out with the same apparatus in Spacelab and on Earth. The experiments addressed a series of scientific questions and useful data were obtained to provide answers to some but not all of those questions. Author

N93-19399*# University of Central Florida, Orlando. Chemistry Dept.
CHEMICAL CHARACTERIZATION OF SOME AQUEOUS LEACHATES FROM CROP RESIDUES IN 'CELSS'
BROOKS C. MADSEN *In its* NASA/ASEE Summer Faculty Fellowship Program p 229-259 Sep. 1992
Avail: CASI HC A03/MF A06

Aqueous leachate samples prepared from crop residues that are produced as a component of the Controlled Ecological Life Support System program designed to support long duration space missions have been compared and general chemical characterization has been accomplished. Solid phase extraction and high performance liquid chromatography were used to accomplish comparisons based on chromatographic and ultraviolet absorption properties of the components that are present. Specific compounds were not identified, however, general composition related to the presence of phenol-like compounds was explored. Author

N93-19751# Brookhaven National Lab., Upton, NY.
THE EFFECTS OF PROLONGED GROWTH IN ELEVATED CO2 CONCENTRATIONS IN THE FIELD ON THE AMOUNTS OF DIFFERENT LEAF PROTEINS
G. Y. NIE (Essex Univ., Colchester, England) and S. P. LONG (Essex Univ., Colchester, England) Sep. 1992 6 p Presented at the 9th International Congress on Photosynthesis, Nagoya, Japan, 30 Aug. - 5 Sep. 1992
(Contract DE-AC02-76CH-00016)
(DE93-002940; BNL-48062; CONF-9208155-3) Avail: CASI HC A02/MF A01

Atmospheric CO2 concentration (C(sub a)) is expected to rise to double pre-industrial concentrations within the next century. Increased Ca may stimulate photosynthetic CO2 uptake (A) in C3 species because of the low affinity of Rubisco for CO2 and by inhibition of RubP oxygenation. Several controlled environment studies have suggested that this potential stimulation may be offset by decreased Rubisco contents and activities in leaves developed at elevated C(sub a), which can be related to decreased photosynthetic capacity in these leaves. This decreased capacity may be an artifact of restriction of below-ground organ development, and hence sink-capacity, imposed by pot size. Four species grown over two or more years in elevated C(sub a) in the field are used to address when changes in Rubisco content are also observed when plants are grown with elevated Ca in the field without restriction on rooting volume and whether Rubisco is the only major leaf protein to show change in quantity in plants grown in elevated c(sub a) over prolonged periods. DOE

N93-19891*# National Aeronautics and Space Administration, Washington, DC.
REGULATORY PHYSIOLOGY DISCIPLINE SCIENCE PLAN
1991 42 p
(NASA-TM-108038; NAS 1.15:108038) Avail: CASI HC A03/MF A01

The focus of the Regulatory Physiology discipline of the Space Physiology and Countermeasures Program is twofold. First, to determine and study how microgravity and associated factors of space flight affect the regulatory mechanisms by which humans adapt and achieve homeostasis and thereby regulate their ability to respond to internal and external signals; and, second, to study selected physiological systems that have been demonstrated to be influenced by gravity. The Regulatory Physiology discipline, as defined here, is composed of seven subdisciplines: (1) Circadian Rhythms, (2) Endocrinology, (3) Fluid and Electrolyte Regulation, (4) Hematology, (5) Immunology, (6) Metabolism and Nutrition, and (7) Temperature Regulation. The purpose of this Discipline Science Plan is to provide a conceptual strategy for NASA's Life Sciences Division research and development activities in the area of regulatory physiology. It covers the research areas critical to NASA's programmatic requirements for the Extended-Duration Orbiter, Space Station Freedom, and exploration mission science activities. These science activities include ground-based and flight; basic, applied, and operational; and animal and human research and development. This document summarizes the current status of the program, outlines available knowledge, establishes goals and objectives, identifies science priorities, and defines critical questions in regulatory physiology. It contains a general plan that will be used by both NASA Headquarters Program Offices and the field centers to review and plan basic, applied, and operational intramural and extramural research and development activities in this area. Author

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AEROSPACE MEDICINE

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

A93-21683
PROTEIN ABSORPTION AND ENERGY DIGESTIBILITY AT HIGH ALTITUDE
BENGT KAYSER, KEVIN ACHESON, JAQUES DECOMBAZ, EDWARD FERN, and PAOLO CERRETELLI (Centre Medical Universitaire, Geneva; Nestec, Ltd., Research Center, Lausanne, Switzerland) Journal of Applied Physiology (ISSN 8750-7587) vol. 73, no. 6 Dec. 1992 p. 2425-2431. Research supported by Nestec, Ltd. and CNR refs
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A hypothesis that malabsorption of dietary protein is partly responsible for the weight loss observed during prolonged altitude exposure has been tested. Six healthy male subjects received 15N-labeled soya protein by mouth and (15N) glycine intravenously at 122 and 5,000 m. Results show that the average decrease of the subjects' weight was 3 percent and loss of fat mass at altitude estimated from skinfold measurements was 9 percent. Protein absorption calculated as 100 percent was not significantly impaired at altitude compared with sea level (96 vs. 97 percent, respectively), and overall digestible energy at altitude, calculated as 100 percent, undigested gross energy in the feces, amounted to 96 percent. It is concluded that malabsorption does not have an impact on altitude-related weight loss up to an altitude of 5000 m. O.G.

A93-21685
OPERATION EVEREST II - METABOLIC AND HORMONAL RESPONSES TO INCREMENTAL EXERCISE TO EXHAUSTION
PATRICIA M. YOUNG, JOHN R. SUTTON, HOWARD J. GREEN, JOHN T. REEVES, PAUL B. ROCK, CHARLES S. HOUSTON, and ALLEN CYMERMAN (U.S. Army, Research Inst. of Environmental Medicine, Natick, MA; McMaster Univ., Hamilton; Waterloo Univ., Canada; Colorado Univ., Denver; Vermont Univ., Burlington) Journal of Applied Physiology (ISSN 8750-7587) vol. 73, no. 6 Dec. 1992 p. 2574-2579. refs
(Contract DAMD17-85-C-5206)
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Peak oxygen uptakes were determined in five normal male subjects with use of progressively increasing cycling work loads at ambient barometric pressures of 760, 380, and 282 Torr. It was found that postexercise concentrations of plasma catecholamines were decreased at altitude compared with sea level. Preexercise lactate and ammonium concentrations were not different at any simulated altitude. It is concluded that neither substrate availability nor metabolic product accumulation limited exercise capacity at extreme simulated altitude. O.G.

A93-21686
CARDIOVASCULAR RESPONSES TO LOWER BODY NEGATIVE PRESSURE IN TRAINED AND UNTRAINED OLDER MEN
SUZANNE FORTNEY, CLARKE TANKERSLEY, J. T. LIGHTFOOT, DONALD DRINKWATER, JON CLULOW, GARY GERSTENBLITH, FRANCES O'CONNOR, LEWIS BECKER, EDWARD LAKATTA, and JEROME FLEG (NIH, National Inst. on Aging, Baltimore, MD)

Journal of Applied Physiology (ISSN 8750-7587) vol. 73, no. 6 Dec. 1992 p. 2693-2700. refs
(Contract NIH-P01-AG4402-05; NIH-RR-02719; NIH-NO1-AG-9-2216)

The objective of the study presented is to compare the cardiovascular responses to an orthostatic challenge between a moderately active control group (C) of older men and highly aerobically trained older athletes (A). It is hypothesized that A would more effectively maintain their cardiac output and blood pressure during an orthostatic challenge. It is found that, during lower body negative pressure (to 50 mmHg), left ventricular end-diastolic and end-systolic volume indexes and stroke volume index decreased in both groups while heart rate increased. The decreases in cardiac volumes and mean arterial pressure and the increase in heart rate between 0 and -50 mmHg were significantly less in A than in C. O.G.

A93-21687
ENERGETICS OF WALKING AND RUNNING - INSIGHTS FROM SIMULATED REDUCED-GRAVITY EXPERIMENTS

CLAIRE T. FARLEY and THOMAS A. MCMAHON (Museum of Comparative Zoology, Concord; Harvard Univ., Cambridge, MA)
Journal of Applied Physiology (ISSN 8750-7587) vol. 73, no. 6 Dec. 1992 p. 2709-2712. Research supported by Alfred P. Sloan Foundation refs
(Contract NIH-R01-AR-18140)

On earth, a person uses about one-half as much energy to walk a mile as to run a mile. On another planet with lower gravity, would walking still be more economical than running? It would seem that if gravity were reduced, energetic cost would decrease in proportion to body weight in both gaits. However, we find that under simulated reduced gravity, the rate of energy consumption decreases in proportion to body weight during running but not during walking. When gravity is reduced by 75 percent, the rate of energy consumption is reduced by 72 percent during running but only by 33 per cent during walking. These results suggest that the link between the mechanics of locomotion and energetic cost is fundamentally different for walking and for running. Author

A93-23151
EFFECT OF PROLONGED ANTIORTHOSTATIC BED REST HYPOKINESIA ON FUNCTIONAL PROPERTIES OF THE NEUROMUSCULAR SYSTEM IN HUMANS [VLIIANIE DLITEL'NOI POSTEL'NOI ANTIORTOSTATICHESKOI GIPOKINEZII NA FUNKTSIONAL'NYE SVOISTVA NERVNO-MYSHECHNOGO APPARATA U CHELOVEKA]

IU. A. KORIAK and I. B. KOZLOVSKAIA (TsNII Sporta, Moscow, Russia) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489) vol. 38, no. 4 July-Aug. 1992 p. 67-75. In Russian. refs

The effect of prolonged antiorthostatic hypokinesia (ANOH) on functional characteristics of M. triceps surae (MTS) was investigated in human subjects subjected to a 120-day-long head-down (-6 deg) bed rest. It was found that 120-day long ANOH resulted in 45.5, 33.7, and 36.7 percent decreases of the maximal force, the maximal voluntary contraction of the MTS, and the maximal twitch response, respectively. The value of the force deficit increased on the average by 60.2 percent, while a relative increase of the MTS force contraction in response to paired nerve irritation decreased. I.S.

A93-24037* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EFFECTS OF SCOPOLAMINE ON AUTONOMIC PROFILES UNDERLYING MOTION SICKNESS SUSCEPTIBILITY

SEBASTIAN H. J. UIJTDEHAAGE (California Univ., Los Angeles), ROBERT M. STERN (Pennsylvania State Univ., University Park), and KENNETH L. KOCH (Pennsylvania State Univ., Hershey) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 1-8. refs
(Contract NAG9-118)

The purpose of this study was to examine the effects of scopolamine on the physiological patterns occurring prior to and during motion sickness stimulation. In addition, the use of physiological profiles in the prediction of motion sickness was evaluated. Sixty subjects ingested either 0.6 mg scopolamine, 2.5 mg methoscopolamine, or a placebo. Heart rate (HR), respiratory sinus arrhythmia (an index of vagal tone), and electrogastrograms were measured prior to and during the exposure to a rotating optokinetic drum. Compared to the other groups, the scopolamine group reported fewer motion sickness symptoms, and displayed lower HR, higher vagal tone, enhanced normal gastric myoelectric activity, and depressed gastric dysrhythmias before and during motion sickness induction. Distinct physiological profiles prior to drum rotation could reliably differentiate individuals who would develop gastric discomfort from those who would not. Symptom-free subjects were characterized by high levels of vagal tone and low HR across conditions, and by maintaining normal (3 cpm) electrogastrographic activity during drum rotation. It was concluded that scopolamine offered motion sickness protection by initiating a pattern of increased vagal tone and gastric myoelectric stability. Author

A93-24039
PROSPECTIVE ASSESSMENT OF STEREOSCOPIC VISUAL STATUS AND USAF PILOT TRAINING ATTRITION

QUAY C. SNYDER, JR. (USAF, School of Aerospace Medicine, Brooks AFB, TX) and DENNIS C. LEZOTTE (Colorado Univ., Denver) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 14-19. refs

Historical reviews of microtropia and research concerning the role of depth perception in military aviation are described. A historical prospective study of student pilots entering U.S. Air Force Undergraduate Pilot Training (UPI) from Oct 1990 through Sep 1991 (FY 90-91) compares UPT attrition rates according to their preselection stereoscopic status (microtropia vs. normal). Univariate and multiple logistic regression analyses do not show significant differences in attrition rates between the two groups, implying that distant stereopsis is not critical to successful completion of UPT. The U.S. Air Force decided in Oct 91 to eliminate near stereoscopic vision screening while retaining distant stereoacuity testing as a criterion for candidates to qualify medically for UPT. Valid rationale for this decision includes simplified and uniform administration of stereoacuity testing, minimizing spurious results, the continued validity of stereopsis testing as a cross-check of other areas of visual function, the uncertain role of stereopsis in critical areas of flight operations, and the large applicant pool competing for a limited number of pilot training positions. Author

A93-24041
SPECTRAL ANALYSIS OF THE ELECTROENCEPHALOGRAPHIC RESPONSE TO MOTION SICKNESS

WILLIAM E. CHELEN, MATTHEW KABRISKY, and STEVEN K. ROGERS (USAF, Inst. of Technology and Armstrong Aerospace Medical Research Lab., Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 24-29. refs

A self-contained 14-channel EEG amplifier and filter system was used to record the EEG during a pre-Coriolis stimulation baseline through to imminent emesis. Power spectral analysis was carried out upon the temporo-frontal signals through the entire period over the delta, theta, and alpha EEG bands. It was found that mean power spectral energy in the delta band during frank sickness increased by a factor of 13.7 over a baseline. EEG power spectral levels in the delta and theta bands increased along with the level of motion sickness symptoms. It is suggested that intense low frequency oscillatory stimulation is being diffusely projected about the central nervous system. The EEG changes, similar to

those seen in partial seizures, and the similarity of the symptom/sign complex in the two disorders, indicate that the pathophysiology and electrophysiology of motion sickness may be a variant of seizure activity. O.G.

A93-24042
EFFECTS OF SIMULATED HIGH ALTITUDE EXPOSURE ON LONG-LATENCY EVENT-RELATED BRAIN POTENTIALS AND PERFORMANCE

NANCY J. WESENSTEN (U.S. Army, Walter Reed Inst. of Research, Washington), JOHN CROWLEY (U.S. Army, Aeromedical Research Lab., Fort Rucker, AL), THOMAS BALKIN, GARY KAMIMORI (U.S. Army, Walter Reed Inst. of Research, Washington), EUGENE IWANYK (U.S. Army, Inst. of Environmental Medicine, Natick, MA), NORMAN PEARSON (U.S. Army, Walter Reed Inst. of Research, Washington), JAMES DEVINE (U.S. Army, Inst. of Environmental Medicine, Natick, MA), GREGORY BELENKY (U.S. Army, Walter Reed Inst. of Research, Washington), and ALLEN CYMERMAN (U.S. Army, Inst. of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 30-36. Research supported by U.S. Army refs

The N100, P200, N200 and P300 components of the auditory event-related potential were recorded from 10 male subjects at 0900, 1600, and 1830 hours at sea level and again following a rapid ascent to simulated 4300 m altitude. Amplitude and latency of components, ear oximetry, and concurrent performance measures were assessed. Amplitude of P300 decreased, while P300 latency and reaction time increased, following ascent to altitude. However, the time course of altitude effects differed for amplitude versus latency. Components N100, P200, N200, and counting errors were unaffected by altitude. The results indicate that central measures of cognitive capacities are differentially sensitive to high altitude. The time course of altitude effects on P300 amplitude versus P300 latency suggests that the two measures reflect different aspects of a response to hypobaric hypoxia exposure. Author

A93-24043
OPERATION EVEREST II - GAS TENSIONS IN EXPIRED AIR AND ARTERIAL BLOOD AT EXTREME ALTITUDE

MARK K. MALCONIAN, PAUL B. ROCK (U.S. Army, Inst. of Environmental Medicine, Natick, MA), JOHN T. REEVES (Colorado Univ., Denver), ALLEN CYMERMAN (U.S. Army, Inst. of Environmental Medicine, Natick, MA), and CHARLES S. HOUSTON (Arctic Inst. of North America, Washington; Vermont Univ., Burlington) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 37-42. Research sponsored by Arctic Inst. of North America refs
(Contract DAMD17-85-C-5206; NIH-HL-14985; NIH-HL-17731)

Measurements in alveolar gas have suggested extreme hypocapnia and alkalosis on the summit of Mt. Everest. However, tensions in both expired gas and arterial blood have not been reported for the summit of Mt. Everest. To approach the problem, we examined alveolar (and end-tidal) and arterial gas tensions in 6 healthy men who completed a 40-d chamber study to the simulated 'summit', with 20 d above 6,400 m and 9 d above 8,000 m. In 27 simultaneous samples of alveolar air and arterial blood for inspired oxygen tensions ranging from P102 of 55 mm Hg (7,380 m) to 43 mm Hg, the mean alveolar-arterial difference was negligible for PO2 and PCO2. For all 6 subjects at the summit, PA(CO2) was 12.0 +/- 1.8 and Pa(CO2) was 11.4 + 1.6 mm Hg, and for the two with the lowest values, alveolar and arterial PCO2, respectively, were 9.5 and 9.8 mm Hg. Arterial pH averaged 7.53 units. We conclude that while acclimatization to severe hypoxia results is extreme hypocapnia, alkalosis is more moderate than previously reported. Alveolar gas tensions reflect well the values obtained in arterial blood. Author

A93-24044
INTRACARDIAC HEMODYNAMICS IN MAN DURING SHORT PERIODS OF HEAD-DOWN AND HEAD-UP TILT

GHISLAINE DEKLUNDER, JEAN-LOUIS LECROART, ELIE CHAMMAS, LUC GOULLARD, and YVON HOUDAS (Univ. Hospitals, Lille, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 43-49. refs

A study aimed at determining the respective importance of the nervous responses via the arterial baroreceptor reflexes and the direct adaptation of the myocardial fiber to the modifications of blood return is presented. The intracardiac hemodynamic responses to short periods of 70 deg head-down and head-up tilts were examined in 12 normal male subjects. Doppler-echocardiographic techniques were used to study the intracardiac and vascular hemodynamics. The shape of arterial peripheral flow revealed an increased vascular impedance. Afer a short drop, the blood pressure rapidly recovered a level statistically close to that of the pretest. In both cases tachycardia occurred. It is concluded that, in man, the cardiac responses to changes in posture are related more to the passive changes in ventricular filling due to the blood shift than to the nervous regulation by the arterial baroreflexes, whereas these reflexes mainly act in the control of the vascular impedance. O.G.

A93-24045
RESPONSE OF THE CIRCADIAN SYSTEM TO 6 DEG HEAD-DOWN TILT BED REST

ALEXANDER SAMEL, HANS-MARTIN WEGMANN, and MARTIN VEJVODA (DLR, Inst. fuer Flugmedizin, Cologne, Germany) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 50-54. refs

The influence of simulated microgravity and reduced zeitgebers on the circadian system was examined in eight subjects. The 12-d study included a 3-d period for baseline measurements, 7 d of 6 deg head-down bed rest, and 2 d for recovery. The sleep-wake cycle was kept constant during the study. Results indicate that only minor changes occurred in rhythm acrophases, whereas daily means for several physiological functions and their circadian amplitudes were significantly altered during the bed-rest phase. These studies using head-down tilt confirm previous findings with horizontal bed rest and indicate that rhythm disturbances can occur without change in the sleep-wake cycle. To the degree that bed-rest studies simulate manned spaceflights, results indicate that variations in circadian cycles can occur even during short-term missions and must be taken into account when interpreting subsequently obtained physiological data. Author

A93-24049
THE PHYSIOLOGICAL CONSEQUENCES OF SIMULATED HELICOPTER FLIGHT IN NBC PROTECTIVE EQUIPMENT

R. THORNTON (U.S. Army, Aeromedical Research Lab., Fort Rucker, AL; Army Air Corps, Stockbridge, United Kingdom) and LYNN CALDWELL (U.S. Army, Aeromedical Research Lab., Fort Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 69-73. Research supported by U.S. Army refs

The physiological effects of wearing U.S. Army aviator nuclear-biological-chemical (NBC) individual protective equipment (IPE) were evaluated in the USAARL UH-60 research flight simulator. There were 16 male aviators who flew the simulator in 4 test conditions: standard flight suit and cool cockpit, standard flight suit and hot cockpit, NBC IPE and cool cockpit, NBC IPE and hot cockpit. The cool condition was a WBGT of 17.9 C, the hot 30.6 C. Rectal temperature, mean skin temperature, and heart rate were monitored and showed significant increases for the NBC hot condition compared with the other three. Seven subjects failed to complete the sortie in the NBC hot condition, with a mean survival time of 298 min. All subjects flew for the target 6 h in the other conditions. Author

A93-25201
THE EFFECTS OF STRUCTURAL FAILURE ON INJURIES SUSTAINED IN THE M1 BOEING 737 DISASTER, JANUARY 1989
BARRIE D. WHITE, JOHN L. FIRTH, JOHN M. ROWLES (Univ. Hospital, Nottingham, United Kingdom) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 95-102. refs

Only 10 occupants escaped uninjured from the wreckage of the East Midlands Boeing 737/400 aircraft accident. The remaining 116 suffered injuries similar in pattern, but ranging in severity from simple bruising to fatal crushing trauma. Overall, the individual's degree of injury and likelihood of death was proportional to the local structural damage of the aircraft. Limb injuries were particularly severe in the forward section of the wreckage where the floor failed. In areas where structural damage appeared to be survivable, a number of passengers suffered disproportionately severe head injuries. Many of these had trauma to the posterior aspect of their head, some of whom died as a result. It is likely that these injuries were caused by falling overhead lockers or unrestrained cabin furniture. The significance of these injuries and their future prevention is discussed. Author

A93-25202
THE EFFECTS OF BRACE POSITION ON INJURIES SUSTAINED IN THE M1 BOEING 737/400 DISASTER, JANUARY 1989
BARRIE D. WHITE, JOHN L. FIRTH, JOHN M. ROWLES (Univ. Hospital, Nottingham, United Kingdom) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 103-109. refs

Of the initial 87 survivors of the East Midlands Boeing 737/400 aircraft, 77 sustained head and facial trauma during the crash, 45 of whom were rendered unconscious. There were 21 who received injuries to the back of their head, including 5 of the 6 severely head-injured adults. Those passengers who adopted the fully flexed 'brace' position for crash-landing achieved significant protection against head injury, concussion, and injuries from behind irrespective of local aircraft structural damage. A computer graphics simulation developed by a commercial firm (H.W. Structures, Ltd.) using the predicted crash pulse of the accident has validated these clinical findings and allows theoretical biomechanical modeling for the design of occupant protection systems in the future. Although the major role of structural failure should not be forgotten, bracing maximizes the chance of uninjured survival in the current generation of aircraft and should be demonstrated and practiced as a pre-flight routine. Author

A93-25203
INFLUENCE OF STRESS ON LYMPHOCYTE SUBSET DISTRIBUTION - A FLOW CYTOMETRIC STUDY IN YOUNG STUDENT PILOTS
ROBERTO BISELLI, STEFANO FARRACE, RAFFAELE D'AMELIO, and ANDREA FATTOROSSI (Aeronautica Militare Italiana, Div. Aerea Studi Ricerche e Sperimentazioni, Pomezia, Italy) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 116-120. refs

Major circulating lymphocyte subsets were quantitated in Italian Air Force student pilots undergoing intensive training and continuous evaluation. Instructor pilots matched for age and assayed in parallel were used as controls. A typical flight training session was not able per se to induce immediate significant modifications of the lymphocyte subset distribution either in the students or instructors, although it did affect plasma levels of stress-related hormones such as growth hormone, prolactin, and cortisol in the former. Irrespective of the time of flying, however, the percentage of CD4(+) lymphocytes and the CD4/CD8 ratio were lower in students than in instructors, and the absolute number of CD8(+) lymphocytes was higher in students than in instructors. In a second series of experiments, 30 student pilots were tested at the beginning and at the end of a flight course (duration 30 days). Although the percentage of CD29(+) lymphocytes comprised in the CD8(+) subset was reduced at the end of the course in all individuals, such a reduction was more evident in those students who failed to pass the final examination, an additional cause of psychological stress. Author

A93-25204
THE EFFECTS OF VARIATIONS IN THE ANTI-G STRAINING MANEUVER ON BLOOD PRESSURE AT +GZ ACCELERATION
J. D. MACDOUGALL, R. S. MCKELVIE, D. E. MOROZ, J. S. MOROZ (McMaster Univ., Hamilton, Canada), and F. BUICK (Defence and Civil Inst. of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 126-131. Research supported by Defence and Civil Inst. of Environmental Medicine refs

The relative effectiveness and fatigability of the two separate mechanisms which cause the increase in blood pressure during the anti-G standard maneuver (AGSM), caused by the forceful contraction of the limb muscles and by the Valsalva maneuver, are investigated in experiments conducted in a human centrifuge. Data include measurements of brachial arterial pressure over a range of intensities of the leg pressure contraction and Valsalva maneuvers, which were conducted at +1 Gz and during slow and rapid onset runs up to +5 Gz. Results showed that a major portion of the elevation in blood pressure caused by the AGSM can be attributed to contraction of the muscles of the lower body and that this component is less fatiguing than the respiratory straining (Valsalva) maneuver. I.S.

A93-25206 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BLOOD VOLUME REDUCTION COUNTERACTS FLUID SHIFTS IN WATER IMMERSION
KARL E. SIMANONOK and EDMUND BERNAUER (California Univ., Davis) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 139-145. Research sponsored by Universities Space Research Association and NASA refs
(Contract NGT-05-004-801)

Six healthy men were bled by 15 percent of their total blood volume (TBV) before 7 h of seated water immersion, to test the hypothesis that some of the major physiological responses to an expansion of central blood volume can be counteracted by prior reduction of TBV. Subjects were their own controls under two conditions: seated dry in air and seated immersed to the suprasternal notch in water. Immersion without prior reduction of TBV Wet Control (WC) caused a statistically significant 22-percent increase in cardiac output (CO), 368-percent increase in urine production, and 200-percent increase in sodium excretion relative to dry control (DC) sessions. When TBV was reduced before immersion, CO was the same as during DC sessions; however there were significant increases above DC in urine flow (+73 percent) and sodium excretion (+120 percent), although they were significantly reduced from WC values. Potassium excretion was similar during DC and WC sessions, but was significantly increased (+75 percent) when subjects were immersed after 15-percent reduction of TBV. Author

A93-25208
STUDY DESIGN FOR MICROGRAVITY HUMAN PHYSIOLOGY EXPERIMENTS
FAITH A. GAGNON, LARK E. SUSAK, NORMAN PHILLIPS, PETER C. WING, and IAN K. Y. TSANG (British Columbia Univ. Hospital, Vancouver, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 153-157. refs

In some areas of research, such as microgravity life sciences, both the number of subjects and the opportunity for repeated observation under experimental conditions are limited. Small N study designs are appropriate for these situations since they require

few subjects and few observations in the experimental condition. Small N studies compare treatment conditions separately for each subject so that between-subject variability does not obscure treatment effects. Multiple observations are collected for each individual in the baseline condition to ensure a stable reference point for comparison with the smaller number of observations collected under the experimental conditions. Individual differences can be overlooked in large N studies, but in small N studies the focus is on the individual, and differences observed between particular individuals can be suggestive of underlying causal processes. We present a step-by-step approach to designing and conducting a small N study. Author

A93-25210
LOWER BODY NEGATIVE PRESSURE SYSTEM FOR SIMULATION OF +GZ-INDUCED PHYSIOLOGICAL STRAIN
C. A. VERGHESE and A. S. K. PRASAD (Defence Bioengineering and Electromedical Lab., Bangalore, India) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 165-169. refs
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Lower body negative pressure (LBNP) can be considered as an experimental substitute for the +Gz stress. In military aviation, pilots assume a near upright position and are subjected to +Gz stress in this position. An LBNP chamber has been developed in which negative pressure can be applied to the subject in the upright seated position. The chamber is easy to fabricate and can be used to assess the tolerance of subjects likely to be exposed to high levels of +Gz stress. Author

A93-25600
FORMATION OF THE HYPOKINETIC SYNDROME IN THE DIGESTIVE SYSTEM UNDER CONDITIONS OF WEIGHTLESSNESS [FORMIROVANIE GIPOKINETICHESKOGO SINDROMA PISHCHEVARITEL'NOI SISTEMY V USLOVIIAKH NEVESOMOSTI]
K. V. SMIRNOV (Inst. Mediko-Biologicheskikh Problem, Moscow, Russia) Fiziologicheskii Zhurnal (ISSN 0015-329X) vol. 78, no. 8 Aug. 1992 p. 93-101. In Russian. refs
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The effect of cosmic flight on the functioning of the gastrointestinal system is investigated using data collected in spaceflight crewmembers of Salyut before, during, and after space flights of various duration. It is found that the gastropancreatic complex was the most sensitive part of the digestive system when the subjects were subjected to weightlessness. The main changes recorded under microgravity included an increase of the peptic potential of the stomach, increases of pancreatic enzymes in the blood, progressive changes in the character of glycemic curves, and decreases of the echo density of the liver and the pancreas. I.S.

A93-25652
THE RHYTHM OF HEART ACTIVITY AND ARRHYTHMIA IN LONG-TERM SPACE FLIGHTS [RITM SERDECHNOI DEIATEL'NOSTI I ARITMII SERDTSA V DLITEL'NYKH KOSMICHESKIKH POLETAKH]
B. M. FEDOROV and Z. A. GOLUBCHIKOVA (Inst. Mediko-Biologicheskikh Problem, Moscow, Russia) Fiziologiia Cheloveka (ISSN 0131-1646) vol. 18, no. 6 Nov.-Dec. 1992 p. 109-115. In Russian. refs
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The characteristics of heart rhythm changes observed during long-term space flights were investigated using ECG records for 16 cosmonauts who flew aboard the Mir space station for time periods from 136 to 366 days. It was found that, in 13 of the subjects, weightlessness was associated with increases in heart rate and episodes of arrhythmia. The greatest deviations from the normal heart activity, characterized by acute tachycardia and extrasystolic allorhythmia, were associated with exposures to emotional and/or physical stress. I.S.

A93-25653
ILLUSIONS OF VISUAL-TARGET MOTION CAUSED BY ELECTRICAL VESTIBULAR STIMULI [ILLIUZII DVIZHENIIA ZRITEL'NOI MISHENI POD DEISTVIEM ELEKTRICHESKOI VESTIBULIARNOI STIMULIATSII]
K. E. POPOV, B. N. SMETANIN, and V. IU. SHLYKOV (RAN, Inst. Problem Peredachi Informatsii, Moscow, Russia) Fiziologiia Cheloveka (ISSN 0131-1646) vol. 18, no. 6 Nov.-Dec. 1992 p. 152-155. In Russian. refs
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The characteristics of the visual-target-motion illusion induced in humans by the electrical stimulation of the vestibular apparatus were investigated with particular attention given to changes associated with the subject's movements and postural changes. It was found that, in the seven subjects under investigation, the threshold of the illusion caused by a monoaural stimulus varied between 0.35 and 0.8 mA. The intensity of illusions increased with the increase of voltage. Postural changes and body movements were accompanied by changes in the quantitative characteristics of illusions: the illusion thresholds increased for subjects in the prone position and decreased during the performance of arbitrary movements while standing. I.S.

N93-17817# Army Aeromedical Research Lab., Fort Rucker, AL.
EFFECTS OF TERFENADINE AND DIPHENHYDRAMINE ON BRAIN ACTIVITY AND PERFORMANCE IN A UH-60 FLIGHT SIMULATOR Final Report
ROBERT L. STEPHENS, JOHN A. CALDWELL, JR., CARLOS A. COMPERATORE, JACQUELYN Y. PEARSON, and DARCELLE M. DELRIE Sep. 1992 67 p
(AD-A258012; USAARL-92-33) Avail: CASI HC A04/MF A01

The effects of terfenadine, diphenhydramine, and a placebo on flight performance, resting electroencephalographic (EEG) activity, and auditory and visual evoked potential tasks were investigated. Twelve male Army aviators served as subjects in a double-blind, repeated measures experimental design. The results indicated that neither diphenhydramine nor terfenadine effected flight performance. Regarding resting EEG, diphenhydramine caused a decrease of alpha power at all electrode sites. For all sites with the exception of Cz, diphenhydramine also caused a decrease of power in the beta band. The P300 component-of the auditory evoked potential was unaffected by either of the drugs. The amplitude of the visual P300 was suppressed under diphenhydramine relative to placebo while the latency was unaffected. The results of this study highlight the importance of measuring multiple aspects of performance in assessing the impact of a drug. While flight performance was unaffected by either drug, the indications from measures of brain activity are that terfenadine is much less sedating. Therefore, it is a more attractive alternative for the treatment of allergic symptoms in the aviator population or in any population where compromised performance is potentially dangerous. GRA

N93-17822# Naval Aerospace Medical Research Lab., Pensacola, FL.
EFFECTS OF DEXTROMETHAMPHETAMINE ON SUBJECTIVE FATIGUE Interim Report
C. A. DEJOHN, S. A. SHAPPELL, and D. F. NERI Aug. 1992 18 p
(AD-A258252; NAMRL-1376) Avail: CASI HC A03/MF A01

Declining aircrew performance during periods of sustained flight operations (SUSOP's) has underscored the need to develop effective countermeasures. This paper reports on the ability of the central nervous system (CNS) stimulant d-methamphetamine to alleviate the detrimental effects of a simulated SUSOP's on subjective fatigue. Subjective fatigue was repeatedly measured by three questionnaires. The simulated SUSOP started at 1800 and consisted of a 9-h planning session followed by 4 h of rest and a 14-h mission. After 6 h of sleep, the 9/4/14 work/rest/work pattern was repeated. At 4 1/2 h into the second mission, 13 subjects were administered 10 mg of d-methamphetamine/70 kg of body mass while 12 subjects received a placebo in a double-blind

procedure. Administration of d-methamphetamine significantly reduced reported fatigue scores on the Addiction Research Center Inventory (ARCI), Mood Questionnaire (MQ), and sleepiness scores on the Stanford Sleepiness Scale (SSS). GRA

N93-17895# Naval Aerospace Medical Research Lab., Pensacola, FL.

AN AUTOMATED VERSION OF THE DICHOTIC LISTENING TEST: HARDWARE, SOFTWARE, AND PROCEDURAL DETAILS

G. B. THOMAS, A. H. MCCARDIE, and D. H. LEWIS Jul. 1992 20 p

(AD-A258114; NAMRL-TM-92-2) Avail: CASI HC A03/MF A01

Hardware, software, and procedural details are presented for creation of a personal computer-based dichotic listening test. The source code is in Microsoft QuickBasic 4.5 and incorporates subject instructions, a practice-to-criterion routine, and automated stimuli presentation and scoring. The original computer platform was an 80286-based computer with a VGA card but the code has been tested with 80386 and 80486 microprocessors and various video modes with no problems. The stimuli are digitized analog signals and are presented through Antex processing cards. Source code and stimuli files are available from the authors. GRA

N93-17896# Naval Aerospace Medical Research Lab., Pensacola, FL.

THE DETECTION OF LATERAL MOTION BY US NAVY JET PILOTS

LEONARD A. TEMME May 1992 16 p

(Contract NR PROJ. M00-96)

(AD-A258115; NAMRL-1368) Avail: CASI HC A03/MF A01

A lateral motion detection test as a vision standard for naval aircrew personnel selection is evaluated. The leftward and rightward threshold velocities of a 1.5-degree spot of light presented in an essentially empty visual field were measured in 110 U.S. Navy fighter pilots. These threshold measurements were compared to similar measurements of nonaviator subjects as reported in the literature. There was no evidence that pilots and non-pilots differed. Air-to-air target detection distances measured during air combat maneuver training were compared to the aviators' velocity thresholds. The statistical evidence of a relationship between the vision and the performance measure was ambiguous and most likely due to sampling effects. Correlation between pilot age and velocity thresholds was not statistically significant. This particular test of lateral motion holds little promise as a useful, practical tool for personnel selection. GRA

N93-17900# Letterman Army Inst. of Research, San Francisco, CA. Div. of Blood Research.

SYSTEMIC AND PULMONARY HYPERTENSION AFTER RESUSCITATION WITH CELL-FREE HEMOGLOBIN Final Report

JOHN R. HESS, VICTOR W. MACDONALD, and WILLIAM D. BRINKLEY Jul. 1992 37 p

(AD-A258185; LAIR-471) Avail: CASI HC A03/MF A01

Human hemoglobin (Hb) and hemoglobin cross-linked between the alpha subunits with bis-(3,5-dibromosalicyl)fumarate (aaHb) were used to treat hemorrhagic shock in water-deprived swine. Water was withheld for 48 hours to induce a 10 percent loss of body mass, and 25 ml/kg of blood was removed over one hour to produce circulatory shock. Swine were resuscitated with Hb, aaHb, human serum albumin, or Ringer's lactate. Mild high-output renal failure was observed in the non-crosslinked Hb-treated animals but not in other groups. Swine treated with Hb and aaHb had increases in plasma creatine kinase and lactate dehydrogenase activity that was resolved by seven days. Both Hb- and aaHb-treated swine displayed marked elevations of mean blood pressure in the systemic (39 +/- 6 Torr) and pulmonary (20 +/- 6 Torr) circulations that continued over three hours and were associated with reduced cardiac output and a doubling of the systemic and pulmonary vascular resistance. Oxygen delivery was equivalent and the rate of correction of the lactic acidosis was equal in all groups. GRA

N93-17918# Naval Aerospace Medical Research Lab., Pensacola, FL.

A REVIEW OF MODELS OF THE HUMAN TEMPERATURE REGULATION SYSTEM Interim Report

L. G. MEYER 18 Feb. 1992 57 p

(AD-A258023; NAMRL-MONOGRAPH-45) Avail: CASI HC A04/MF A01

Over the last 100 years, models of temperature regulation have improved our understanding of the body's response to cold as much as scientific experimentation. Models have taken many forms, that is, verbal, pictorial, mechanical, mathematical, and have always been used to predict the body's thermal behavior in changing environmental conditions. Some models have been based on experimental data and some on theories of thermodynamics. As science has advanced, models have become increasingly more complex. However, the use of powerful, high-speed computers has enabled simulations to achieve a formidable level of predictability. Despite the increasing number and sophistication of models of temperature regulation, we have not reached the point where the computer simulation predicts accurately and entirely the complex interactions of the human body. There are many gaps to be filled. This review highlights the development of different models of the biological process of temperature regulation. The objective is to demonstrate the remarkable achievements of models as contributions to the advancement of our knowledge of human temperature regulation, while, at the same time, suggest the need for more explicit and accurate models that include important and previously excluded interactions between physiological systems, such as the cardiovascular and endocrine systems. GRA

N93-17926# Naval Medical Research Inst., Bethesda, MD.

STATISTICALLY BASED DECOMPRESSION TABLES 8: LINEAR-EXPONENTIAL KINETICS Technical Report, Aug. 1990 - Oct. 1991

E. C. PARKER, S. S. SURVANSHI, E. D WEATHERSBY, and E. D. THALMANN Sep. 1992 62 p

(Contract NR PROJ. M00-99)

(AD-A257613; NMRI-92-73) Avail: CASI HC A04/MF A01

Probabilistic models applied to diving decompression data have been successful in describing decompression sickness (DCS) occurrence and even time of DCS occurrence. This study explores a class of models using linear as well as exponential gas exchange kinetics to provide slower tissue washout than previous models. The models consist of 3 or 4 kinetic compartments, each of which can employ purely exponential (EE) or mixed linear-exponential (LE) kinetics. The risk of DCS is obtained from the single or double integration of the sum of compartment over-pressures. The resulting four models, EE1, EE2, LE1, and LE2 cover a broad range of gas kinetic possibilities. The data used in fitting these models are compiled from U.S. Navy, Canadian, and British chamber dive trials. There are 799 different dive profiles, representing 2383 man-dives, with a DCS incidence of 5.8 percent (131 DCS cases, 75 marginal cases). Time of DCS occurrence information is included for all decompression sickness, maximum likelihood, probabilistic modelling, gas exchange kinetics. DCS and many marginal cases. Maximum Likelihood fitting of the four models to these data indicate LE1 to be the best fit. The LE1 Model is able to predict DCS occurrence in the fitted data, as categorized by type of dive profile, risk level, and time of DCS occurrence. LE1 is able to predict DCS occurrence well in most data not used for fitting, with the exception of profiles using high percentage O2 breathing mixtures and some repetitive profiles. GRA

N93-17985# Naval Medical Research and Development Command, Bethesda, MD.

BEHAVIORAL EFFECTS OF HIGH PEAK POWER MICROWAVE PULSES: HEAD EXPOSURE AT 1.3 GHZ

J. A. DANDREA, B. L. COBB, and J. C. KNEPTON, JR. Aug. 1992 17 p

(AD-A258136; NAMRL-1372) Avail: CASI HC A03/MF A01

To investigate behavioral performance effects of localized exposure to the head of very high-peak-power microwaves, rhesus monkeys (Macaca mulatta) were trained on a vigilance task. The

task consisted of responding on one lever for a variable interval (VI - 30s) schedule and then responding on a second lever for food pellet reward. Monkeys were exposed for 25 min to 1.3-GHz microwave energy pulsed at 7, 9, and 11 pps. The pulse duration was 7 microsec with a peak power of 3.06 MW. Microwaves were delivered to the posterior of the head by an open-end waveguide irradiator. Average specific absorption rate (SAR) in the head ranged from 16.0 to 35.0 W/kg. The microwave period was preceded by a 25-min pre-exposure period and followed by a 25-min post-exposure period, each separated by a 1-min extinction period. Response rate on the VI lever decreased only at 26.0 and 35.0 W/kg compared to sham exposure sessions. Reaction time and post-reinforcement pause were unchanged in the exposed conditions relative to shams. GRA

N93-18006# California Univ., Berkeley. School of Optometry.
SPATIO-TEMPORAL MASKING: HYPERACUITY AND LOCAL ADAPTATION Final Report, 1 Jan. 1989 - 31 Jul. 1992
STANLEY A. KLEIN 8 Oct. 1992 9 p
(Contract AF-AFOSR-0238-89)
(AD-A257934; AFOSR-92-0950TR) Avail: CASI HC A02/MF A01

Four areas of research are presented. First, models of human vision were applied to image compression and image fidelity for both static and dynamic images. The role of the human observer in JPEG compression was clarified. The human observer's visual information capacity was calculated to be about 20 bits/sq min, substantially higher than previous estimates. New formulas were developed for the Fourier transform of JPEG basis functions. This connected JPEG quantization matrices to the human observer's contrast sensitivity function. Crawford masking was used to measure the visibility of lines and edges following abrupt luminance changes. The high frame rates produced higher temporal resolution than previous studies. A striking asymmetry between light and dark lines was found. Second, a robust test-pedestal framework was developed for modeling spatio-temporal vision with fewer assumptions than previous models. In this framework motion processing and hyperacuity thresholds are directly related to contrast processing. Third, a number of studies on motion processing developed new limits on the human visual system's capabilities. Finally, in order to connect psychophysics results to underlying physiological mechanisms, new techniques were developed for nonlinear analysis and source localization of visual evoked potentials and other biopotentials. GRA

N93-18108* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 370)
Jan. 1993 80 p
(NASA-SP-7011(370); NAS 1.21:7011(370)) Avail: CASI HC A05

This bibliography lists 219 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Dec. 1992. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance. Author

N93-18159# Air War Coll., Maxwell AFB, AL.
A PARADIGM SHIFT IN AIR FORCE MEDICINE
EDWARD A. MILLER May 1992 45 p
(AD-A258334) Avail: CASI HC A03/MF A01

Air Force medicine has been utilizing a quality assurance (QA) program for little less than a decade. The momentous success of total quality management (TQM) in the industrial business is starting to spill over into the American medical business in the form of continuous quality improvement (CQI). A QA program is a mandated, externally driven reactive program which focuses on the provider and who did it. CQI in contrast is proactive, internally driven, fosters participation, and focuses on process improvement and what is wrong. QA programs are set up to identify those individuals who deviate far from the norm. CQI focuses on the norm and continuously improves the norm. My thesis is that Air Force medicine must transition from QA to CQI. GRA

N93-18209# Naval Health Research Center, San Diego, CA.
MUSCLE GLYCOGEN, FIBER TYPE, AEROBIC FITNESS, AND ANAEROBIC CAPACITY OF WEST COAST US NAVY SEA-AIR-LAND PERSONNEL (SEALS) Final Report, Dec. 1990 - Nov. 1991
IRA JACOBS, W. K. PRUSACZYK, and HAROLD W. GOFORTH, JR. Jul. 1992 31 p
(Contract DA PROJ. MM3-3-P-30)
(AD-A258364; NHRC-92-10) Avail: CASI HC A03/MF A01

Thirty-eight Navy SEALs performed aerobic fitness and maximal anaerobic capacity tests on a cycle ergometer. Lactic acid concentration was measured in blood samples taken during the aerobic fitness test. After recording prior dietary intake and physical activity, thirty-six subjects had biopsies taken from the vastus lateralis muscle. Biopsy results showed that SEALs averaged 55 percent fast twitch muscle fiber type. The muscle samples had a mean glycogen concentration of 404 +/- 128 mmol/kg. Biopsy results show that SEALs have an unremarkable fiber type composition and a muscle glycogen concentration that may put them at risk of insidious glycogen depletion over successive deployment days. Muscle glycogen concentration was significantly correlated with 2-day dietary carbohydrate (CHO) intake normalized for body weight. Blood lactate concentration during submaximal exercise suggests that SEALs' aerobic fitness was somewhat low; anaerobic capacity tests show that SEALs would benefit from: (1) increasing CHO intake to enhance premission muscle glycogen; and (2) engaging in combined aerobic/anaerobic training using established principles of mode specificity, frequency,intensity, and duration of exercise. GRA

N93-18210# Naval Health Research Center, San Diego, CA.
THE US NAVY HEALTHY BACK PROGRAM: EFFECT ON BACK KNOWLEDGE AMONG RECRUITS Interim Report
SUSAN I. WOODRUFF, TERRY L. CONWAY, and LEON BRADWAY Aug. 1992 22 p
(Contract DA PROJ. M00-95)
(AD-A258368; NHRC-92-12) Avail: CASI HC A03/MF A01

To address the high prevalence and costs associated with low back pain, U.S. Navy physical therapists currently provide back injury prevention education to requesting commands in the form of the Healthy Back Program. Although the content of the Healthy Back Program has face validity and is similar to other back education interventions, no explicit evaluation of its effectiveness has been conducted. Because of the need to develop effective and practical health interventions, a formal study is needed. A broader evaluation study will make use of a longitudinal, treatment-control group design to test the effects of the Healthy Back Program on back injuries among Navy recruits. The primary purposes of the present study are as follows: (1) present findings examining the immediate effect of the Healthy Back Program in changing knowledge about back injury prevention, and (2) provide a baseline assessment of back problems among incoming recruits. Correlates of back pain also are examined to suggest factors that may be amenable to intervention. GRA

N93-18211# Marine Biological Lab., Woods Hole, MA.
ABSTRACTS OF PAPERS PRESENTED AT THE ANNUAL MEETING OF THE SOCIETY OF GENERAL PHYSIOLOGISTS
13 Sep. 1992 81 p Meeting held at Woods Hole, MA, 10-13 Sep. 1992
(AD-A257718) Avail: CASI HC A05/MF A01

Abstracts of the papers presented at the forty sixth annual meeting of the Society of General Physiologists are included. L.R.R.

N93-18217# Naval Aerospace Medical Research Lab., Pensacola, FL.
AVIATION MEDICINE RESEARCH: A HISTORICAL REVIEW Final Report

R. E. MITCHELL 18 Nov. 1992 51 p
(AD-A258198; NAMRL-SR92-3) Avail: CASI HC A04/MF A01

On July 26, 1988, the commanding officer established the Ashton Graybiel Lecture Series to honor the former scientific director of the Naval Aerospace Medical Research Laboratory. Like Dr. Graybiel, this lecture series is intended to stimulate and challenge conventional research interests in naval aviation and aerospace medicine. As a pioneer in the field of aviation medicine for over 40 years, Dr. Graybiel made many significant scientific contributions, which cannot be overstated. His world-renowned work advanced current aeromedical knowledge and established the reputation of this laboratory. Today, his expertise, foresight, and creativity remain as benchmarks in our aviation medicine research. We are committed to the same level of excellence in meeting the needs of the fleet that Dr. Graybiel accomplished during four decades of research. A historical review of aviation medicine research is presented by Dr. Robert E. Mitchell, Medical Corps, U.S. Navy. GRA

N93-18223# California Univ., Irvine. Dept. of Cognitive Sciences.
CLASSIFICATION OF COMPLEX SOUNDS Semiannual Progress Report, 1 May - 31 Oct. 1992
BRUCE G. BERG 31 Oct. 1992 14 p
(Contract N00014-92-J-1164)
(AD-A258405) Avail: CASI HC A02/MF A01

We have identified at least two factors which characterize listeners' abilities to discriminate complex spectra. One is the ability to integrate information across different auditory channels. Using COSS analysis, we have found that good listeners show spectral weights that are close to optimal, whereas poor listeners show weights which deviate from optimal weights. A second factor is internal noise, that is, the inherent variability of listeners. We have developed a model which incorporates both factors. An important aspect of this model is that it has no free parameters. Estimates of spectral weights and internal noise are completely determined by a trial-by-trial analysis of the data. Predictions are very consistent with thresholds obtained in a profile analysis task. GRA

N93-18252# Lehigh Univ., Bethlehem, PA. Center for Solid State Studies.
ELECTRICALLY MODIFIABLE NONVOLATILE SONOS SYNAPSES FOR ELECTRONIC NEURAL NETWORKS Final Report, 1 Sep. 1989 - 30 Sep. 1992
MARVIN H. WHITE, CHUN-YU M. CHEN, MARGARET FRENCH, and AMIT BANERJEE 30 Sep. 1992 40 p
(Contract N00014-89-J-3149)
(AD-A258318) Avail: CASI HC A03/MF A01

This research addresses the implementation of an electronic element, which emulates the biological synaptic interconnection, in an artificial electronic neural system. The basic interconnection, or the weight, consists of an electrically reprogrammable, nonvolatile, analog conductance which programs at 5V levels. In addition, the fabrication technology for this synaptic interconnection is compatible with existing CMOS VLSI processes. The attractive features of this synaptic weight will be discussed in this report. Furthermore, this report examines the material needs, the device structures, the use of the synaptic weights in a two-tap weight linear adaptive neural-like circuit and the issue of integrating both the synaptic weight elements and the peripheral circuit onto a single silicon wafer. GRA

N93-18264# Hahnemann Medical Coll. and Hospital, Philadelphia, PA. Dept. of Physiology and Biophysics.
THE ROLE OF CENTRAL MONOAMINERGIC SYSTEMS IN AROUSAL AND SELECTIVE ATTENTION Final Technical Report, 1 Apr. 1988 - 31 Mar. 1992
BARRY D. WATERHOUSE 31 Mar. 1992 13 p
(Contract AF-AFOSR-0138-87)
(AD-A258500; AFOSR-92-0911TR) Avail: CASI HC A03/MF A01

The work described here is part of an ongoing set of studies aimed at characterizing the physiological actions and anatomical organization of the monoaminergic projection systems to the rat cerebral cortex. The underlying theme of this work is that the endogenous monoamines, norepinephrine (NE) and serotonin (5-HT), serve to modulate central neuronal responsiveness to afferent synaptic inputs and by so doing participate in the cognitive process of selective attention. Individual studies conducted during the period of support have investigated: 1) the effects of NE and 5-HT on postsynaptic membrane responses of cortical neurons (layers 2/3 and 5) to threshold and subthreshold level stimulation of synaptic input pathways; 2) the effects of NE and 5-HT on receptive field and tuning properties of rat and cat visual cortical neurons; 3) the distribution of locus coeruleus and dorsal raphe neurons that project to principal relay sites along the visual and somatosensory pathways in rats; and 4) the actions of cocaine on response properties of central neurons. Overall, these data provide further support for the contention that the diffusely distributed monoamine systems of the mammalian brain may enhance the performance of target neuronal circuits as a function of changing behavioral conditions. GRA

N93-18280# Naval Aerospace Medical Research Lab., Pensacola, FL.
A COMPUTER-BASED VISUAL ANALOG SCALE
C. A. DEJOHN, M. J. MARR, E. A. MOLINA, and A. H. MCCARDIE Jun. 1992 26 p
(Contract NR PROJ. M00-96)
(AD-A258152; NAML-TR-92-1) Avail: CASI HC A03/MF A01

Although substantial literature exists on visual analog scales (VAS), much is directed toward the clinical assessment of pain. As part of a Naval Aerospace Medical Research Laboratory (NAMRL) effort to investigate the chronopharmacokinetics of methamphetamine during simulated sustained flight operations we developed a computerized VAS to determine the intensity of subjective responses associated with the administration of the stimulant. With simple modifications to the program, the questionnaire could be modified and used to test subjects' responses to a number of drugs, with better resolution of response than hand-scored methods allow. GRA

N93-18292# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE EFFECT OF COMBAT ON THE WORK/REST SCHEDULES AND FATIGUE OF A-6 AND F-14 AVIATORS DURING OPERATION DESERT SHIELD/STORM Final Report
DAVID F. NERI and SCOTT A. SHAPPELL Aug. 1992 29 p
(AD-A258146; NAMRL-1375) Avail: CASI HC A03/MF A01

During Operation Desert Shield/Storm, A-6 and F-14 aviators aboard USS AMERICA completed daily activity logs and provided subjective measures of fatigue. Aviators flew frequently at night during Desert Storm, but without substantial sleep-related fatigue or problems. A likely contributing factor was the large number of naval aviation assets brought into the combat theater, allowing workload to be shared and activity and rest times to be properly managed. However, raster plots of the data suggest that there may have been an additional contributing factor. The AMERICA travelled eastward from the east coast through seven time zones and became involved in combat shortly after arrival in the Red Sea. This pattern of travel may have given AMERICA's aircrew flying at night a significant advantage over those already operating in the area. If the circadian clocks of AMERICA's aircrew had not fully adapted to local time upon arrival, local night flights were closer to being evening flights on body time. Aircrew may not have been experiencing troughs in their circadian cycles during local night flights, at least for the early part of the war. This would result in a smaller physical challenge to overcome. This situation would likely not hold for aircrew who had been in the region for longer periods, nor would it occur for future conflicts closer to the originating time zone. We recommend the incorporation into battle strategy of information about the circadian phase of combatants (as well as sleep logistics) to help prepare them to fight at suboptimal times. GRA

N93-18295# Wisconsin Univ., Madison. Dept. of Medical Physics.
X RAY SYSTEM, LIGHTWEIGHT MEDICAL (XRSLM) Final Report, 21 Dec. 1987 - 31 Mar. 1992
MELVIN P. SIEDBAND, FRANK C. GRENZOW, CRAIG A. HEILMAN, and ROBERT C. BRUCE 10 Aug. 1992 62 p
(Contract DAMD17-88-C-8058; DA PROJ. 3M4-63807-D-836)
(AD-A258159) Avail: CASI HC A04/MF A01

The X-Ray System, Lightweight Medical (XRSLM) is intended for use as a general purpose x-ray system. The original concept was developed on an earlier contract, DAMD17-86C-6039. The system is compact and stored in four containers until ready for assembly. The system is powered by rechargeable NiCd cells or from 110 vac power lines. Unlike a conventional 10 kWp system, which would require line power capacity of 10 kW, the XRSLM requires less than 0.2 kW input power. Conventional battery-powered mobile x-ray machines, batmobiles, weigh about 350 kg while this design weighs less than 90 kg. Unlike most conventional mobile systems, the XRSLM uses a grid for the reduction of the effects of scattered radiation, automatic exposure control, and semi-automatic collimation to improve image quality and to reduce the exposure to both patient and operator. The XRSLM may be assembled, transported and positioned by one operator. It is designed for use with conventional radiolucent tables and litters or operated as a free-standing chest radiographic device. It may also be used with a chair for head and dental radiography. The mechanical configuration is similar to that of the Basic Radiological System (BRS) of the World Health Organization (WHO). GRA

N93-18301# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
VALIDITY OF CLINICAL COLOR VISION TESTS FOR AIR TRAFFIC CONTROL SPECIALISTS Final Report
HENRY W. MERTENS and NELDA J. MILBURN Oct. 1992 14 p
(AD-A258219; DOT/FAA/AM-92/29) Avail: CASI HC A03/MF A01

An experiment on the relationship between aeromedical color vision screening test performance and performance on color-dependent tasks of Air Traffic Control Specialists was replicated to expand the data base supporting the job-related validity of the screening tests. The original experiment (Mertens, 1990; n=108), and the replication (n=136) involved a total of 121 normal trichromats, 31 simple and 44 extreme anamalous trichromats, and 48 dichromats; both protans and deutans were included. The simulations of ATCS color tasks which served as validation criteria were flight progress strips (en route centers), aircraft lights and the Aviation Signal Light indicator (ATC terminal operations), and color weather radar (flight service station and en route center facilities). The validities Kappa of aeromedical screening tests ranged from 0.44 to 0.91 for prediction of error-free performance on all color dependent tasks. The aeromedical screening tests were generally acceptable in terms of selecting individuals who did not make errors, but several tests had high false alarm rates. The high job-related validity of several aeromedical color vision tests was confirmed. GRA

N93-18362# Aerospace Medical Research Labs., Brooks AFB, TX.
THE PROCEEDINGS OF THE HYPOBARIC DECOMPRESSION SICKNESS WORKSHOP Final Report
ANDREW A. PILMANIS Jun. 1992 632 p Workshop held in Brooks AFB, TX, 16-18 Oct. 1990
(Contract AF PROJ. 7930)
(AD-A257612; AL-SR-1992-0005) Avail: CASI HC A99/MF A06

Decompression sickness (DCS) is the clinical condition resulting from evolved inert gas bubbles in tissues caused by a reduction of environmental pressure. It is recognized that DCS continues to be an operational limitation in both aviation and space activities. Furthermore, it is expected that the crews of the next generation of military aircraft will be exposed to even higher altitudes. In order to document the current understanding of altitude decompression sickness and ascertain the operational significance of this disease, a workshop was held at the USAF Armstrong Laboratory (AL) (formerly USAF School of Aerospace Medicine), Brooks Air Force Base, Texas, on 16-18 October 1990. The meeting was sponsored by: (1) USAF AL; (2) NASA Johnson Space Center; and (3) AF Office of Scientific Research, and was attended by over 50 participants representing the Department of Defense (DOD), NASA, and university researchers. The reported incidence of altitude DCS is likely inaccurate due to potential career consequences. Efforts toward reporting with impunity were recommended. It was emphasized that DCS should be viewed as an occupational illness in the same way we view other physiological responses to environmental stress. GRA

N93-18363# Maryland Inst. for Emergency Medical Services, Baltimore.
DEVELOPMENT AND ENHANCEMENT OF A MODE OF PERFORMANCE AND DECISION MAKING UNDER STRESS IN A REAL LIFE SETTING Quarterly Report No. 6
COLIN F. MACKENZIE 1 Nov. 1992 7 p
(Contract N00014-91-J-1540)
(AD-A257796) Avail: CASI HC A02/MF A01

The focus of the present quarter has been on using the scoring system identified in our last quarterly report. We have tested the stressor scoring system by analyzing video tapes of patient resuscitations that have high trauma indices. The trauma index is obtained by adding three independent variables of ASA, AIS and TAG together. We have abstracted physiological data that is outside the ranges of normality. We believe that physiological variables (heart rate, blood pressure etc.) outside the range of normality increase stress on the anesthesiologist managing the patient. To tell this hypothesis we are comparing the stressors scores during abnormal physiological data with those obtained in the same patients and with the same trauma resuscitation team when the vital signs were stabilized. In addition to establishing whether abnormal physiological data is associated with high stressor scores the comparisons between scores made before and after successful resuscitation will enable us to better characterize what is and what is not stressful we will also be comparing team communications before and after completion of resuscitation. GRA

N93-18375*# Office of Space Science and Applications, Washington, DC. Life Sciences Div.
SPACE RADIATION HEALTH PROGRAM PLAN
Nov. 1991 37 p
(NASA-TM-108036; NAS 1.15:108036) Avail: CASI HC A03/MF A01

The Space Radiation Health Program intends to establish the scientific basis for the radiation protection of humans engaged in the exploration of space, with particular emphasis on the establishment of a firm knowledge base to support cancer risk assessment for future planetary exploration. This document sets forth the technical and management components involved in the implementation of the Space Radiation Health Program, which is a major part of the Life Sciences Division (LSD) effort in the Office of Space Science and Applications (OSSA) at the National Aeronautics and Space Administration (NASA). For the purpose of implementing this program, the Life Sciences Division supports scientific research into the fundamental mechanisms of radiation effects on living systems and the interaction of radiation with cells, tissues, and organs, and the development of instruments and processes for measuring radiation and its effects. The Life Sciences Division supports researchers at universities, NASA field centers, non-profit research institutes and national laboratories; establishes interagency agreements for cooperative use and development of facilities; and conducts a space-based research program using available and future spaceflight vehicles. Author

N93-18376*# George Washington Univ., Washington, DC.
PUBLICATIONS OF THE SPACE PHYSIOLOGY AND COUNTERMEASURES PROGRAM, CARDIOPULMONARY DISCIPLINE: 1980-1990

JANET V. POWERS, JANICE WALLACE-ROBINSON, KATHERINE J. DICKSON, and ELIZABETH HESS Nov. 1992 113 p
(Contract NASW-4324)
(NASA-CR-4475; NAS 1.26:4475) Avail: CASI HC A06/MF A02

A 10-year cumulative bibliography of publications resulting from research supported by the Cardiopulmonary Discipline of the Space Physiology and Countermeasures Program of NASA's Life Sciences Division is provided. Primary subjects included in this bibliography are Fluid Shifts, Cardiovascular Fitness, Cardiovascular Physiology, and Pulmonary Physiology. General physiology references are also included. Principal investigators whose research tasks resulted in publication are identified. Publications are identified by a record number corresponding with their entry in the Life Sciences Bibliographic Database, maintained at the George Washington University. Author

N93-18381*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TARGET FRAGMENTATION IN RADIOBIOLOGY
JOHN W. WILSON, FRANCIS A. CUCINOTTA, JUDY L. SHINN, and LAWRENCE W. TOWNSEND Washington Feb. 1993 26 p Presented at the Investigators Meeting on Space Radiation Research, Houston, TX, 22-23 Apr. 1991
(Contract RTOP 199-04-16-11)
(NASA-TM-4408; L-17138; NAS 1.15:4408) Avail: CASI HC A03/MF A01

Nuclear reactions in biological systems produce low-energy fragments of the target nuclei seen as local high events of linear energy transfer (LET). A nuclear-reaction formalism is used to evaluate the nuclear-induced fields within biosystems and their effects within several biological models. On the basis of direct ionization interaction, one anticipates high-energy protons to have a quality factor and relative biological effectiveness (RBE) of unity. Target fragmentation contributions raise the effective quality factor of 10 GeV protons to 3.3 in reasonable agreement with RBE values for induced micronuclei in bean sprouts. Application of the Katz model indicates that the relative increase in RBE with decreasing exposure observed in cell survival experiments with 160 MeV protons is related solely to target fragmentation events. Target fragment contributions to lens opacity given an RBE of 1.4 for 2 GeV protons in agreement with the work of Lett and Cox. Predictions are made for the effective RBE for Harderian gland tumors induced by high-energy protons. An exposure model for lifetime cancer risk is derived from NCRP 98 risk tables, and protraction effects are examined for proton and helium ion exposures. The implications of dose rate enhancement effects on space radiation protection are considered. Author

N93-18596*# Good Samaritan Hospital and Medical Center, Portland, OR. Clinical Vestibular Lab.
ROLE OF ORIENTATION REFERENCE SELECTION IN MOTION SICKNESS Semiannual Status Report
ROBERT J. PETERKA and F. OWEN BLACK Jul. 1992 6 p
(Contract NAG9-117)
(NASA-CR-191912; NAS 1.26:191912) Avail: CASI HC A02/MF A01

The overall objective of this proposal is to understand the relationship between human orientation control and motion sickness susceptibility. Three areas related to orientation control will be investigated. These three areas are (1) reflexes associated with the control of eye movements and posture, (2) the perception of body rotation and position with respect to gravity, and (3) the strategies used to resolve sensory conflict situations which arise when different sensory systems provide orientation cues which are not consistent with one another or with previous experience. Of particular interest is the possibility that a subject may be able to ignore an inaccurate sensory modality in favor of one or more other sensory modalities which do provide accurate orientation reference information. We refer to this process as sensory selection. This proposal will attempt to quantify subjects' sensory selection abilities and determine if this ability confers some immunity to the development of motion sickness symptoms. Measurements of reflexes, motion perception, sensory selection abilities, and motion sickness susceptibility will concentrate on pitch and roll motions since these seem most relevant to the space motion sickness problem. Vestibulo-ocular (VOR) and oculomotor reflexes will be measured using a unique two-axis rotation device developed in our laboratory over the last seven years. Posture control reflexes will be measured using a movable posture platform capable of independently altering proprioceptive and visual orientation cues. Motion perception will be quantified using closed loop feedback technique developed by Zacharias and Young (Exp Brain Res, 1981). This technique requires a subject to null out motions induced by the experimenter while being exposed to various confounding sensory orientation cues. A subject's sensory selection abilities will be measured by the magnitude and timing of his reactions to changes in sensory environments. Motion sickness susceptibility will be measured by the time required to induce characteristic changes in the pattern of electrogastrogram recordings while exposed to various sensory environments during posture and motion perception tests. The results of this work are relevant to NASA's interest in understanding the etiology of space motion sickness. If any of the reflex, perceptual, or sensory selection abilities of subjects are found to correlate with motion sickness susceptibility, this work may be an important step in suggesting a method of predicting motion sickness susceptibility. If sensory selection can provide a means to avoid sensory conflict, then further work may lead to training programs which could enhance a subject's sensory selection ability and therefore minimize motion sickness susceptibility. Author

N93-18952# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A TOPOSCOPIC INVESTIGATION OF BRAIN ELECTRICAL ACTIVITY INDUCED BY MOTION SICKNESS M.S. Thesis
DWIGHT A. ROBLYER Dec. 1992 186 p
(AD-A259024; AFIT/GSO/ENG/92D-03) Avail: CASI HC A09/MF A02

A toposcope was constructed as a new tool to study signal frequency and phase relationships in electroencephalogram (EEG) records collected while subjects were experiencing motion sickness. This new tool, named TOPOS, is a software-based, multi-featured version of Grey Walter and Harold Shipton's device which they first produced in the late 1940's. The TOPOS graphical display permits the study of instantaneous frequency relationships between the input channels and a reference signal of fixed or varying frequency. TOPOS adds a correlation grid to aid observers in detecting channel-to-reference correlation levels. Users can also vary several display parameters via menus to optimize the analysis environment. Sinusoidal test inputs of known frequency produced recognizable and predictable patterns on the TOPOS display, depending on the existing channel-to-reference frequency relationships. Motion-sickness-affected EEG was input to TOPOS in order to study the correlation between the displays of each channel and four separate references: a 1.5-Hz sinusoid, and three channels of the EEG itself. Rapidly varying correlations were observed in each case. GRA

N93-19072# Army Research Inst. of Environmental Medicine, Natick, MA.
VALIDATION OF TWO TEMPERATURE PILL TELEMETRY SYSTEMS IN HUMANS DURING MODERATE AND STRENUOUS EXERCISE
LOU A. STEPHENSON, MARK D. QUIGLEY, LAURIE A. BLANCHARD, DEBORAH A. TOYOTA, and MARGARET A. KOLKA Oct. 1992 86 p
(AD-A259068; USARIEM-T10-92) Avail: CASI HC A05/MF A01

Thermoregulatory strain occurs in soldiers during field and laboratory tests of military equipment and systems. In laboratory tests, either rectal or esophageal temperature of the volunteers is monitored to ensure that internal body temperature (core temperature) does not exceed safe clinical limits. Each of these core temperature indices is reproducible and not biased by environmental temperature; however, the slow response time of rectal temperature is well known. Esophageal temperature measurements are not used in the field, but are routinely used in

laboratory tests which are concerned with the study of thermoregulation. Rectal temperature measurements are used as a index of core temperature in the field and in some types of laboratory studies of exercise and heat stress responses. In the field, it is not always practical to monitor core temperature because volunteers reject the use of rectal probes as a clinical thermometer or the current portable system requires that a medical observer be close to the volunteer at all times. This methodology interferes with field exercises and requires large numbers of medical observers. For example, a medical observer would effectively disrupt the military mission of a tank crew while he monitors the core temperature of each crew member. A solution to monitoring core temperature during field exercises would be to monitor core temperature at an accepted internal site and to transmit the core temperature responses some distance from the test using telemetry. In this way, the medical observer could communicate to the crew or individual when core temperature limits have been exceeded. Alternatively, the individual could carry a temperature telemetry data logger that contained an alarm which would be activated if a core temperature safety limit were exceeded during the field exercise. GRA

N93-19369# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

RETINAL MODELING: SEGMENTING MOTION FROM SPATIO-TEMPORAL INPUTS USING NEURAL NETWORKS M.S. Thesis

DAVID E. SWANSON Dec. 1992 188 p
(AD-A258854; AFIT/GSO/ENG/92D-04) Avail: CASI HC A09/MF A02

Two first-order, linear, time-varying, differential equations were applied to the task of segmenting motion from sequences of images. The equations are modified Grossberg formulas for long-term and short-term memory models characterizing the neurotransmitter and cell-activity levels of a synapse and neuron. How a two layered, sensory, neural network can be built is described using the equations to simulate the amacrine neurons of the retina. The model is defined using adaptive input nodes (adaptive model) and is compared to a similar model without these nodes (Ogmen and Gagne model). By replicating the basic amacrine neuron model to form both one- and two-dimensional arrays, a method was created for processing images over time and space. To simulate the veto effect observed in shunt inhibitory synaptic junctions, a nonrecurrent, asynchronous, inhibitory region in the receptive field of the amacrine neural model was applied. It is shown how this effects the performance of the model in one dimension. In two dimensions, the models' response to synthesized imagery (pristine) and to real, forward looking infrared radar (FLIR) images was investigated. The output of the models are further processed through two types of moving-average filters - causal and noncausal. GRA

N93-19648*# National Aeronautics and Space Administration, Washington, DC.

CARDIOPULMONARY DISCIPLINE SCIENCE PLAN

1991 29 p
(NASA-TM-108040; NAS 1.15:108040) Avail: CASI HC A03/MF A01

Life sciences research in the cardiopulmonary discipline must identify possible consequences of space flight on the cardiopulmonary system, understand the mechanisms of these effects, and develop effective and operationally practical countermeasures to protect crewmembers inflight and upon return to a gravitational environment. The long-range goal of the NASA Cardiopulmonary Discipline Research Program is to foster research to better understand the acute and long-term cardiovascular and pulmonary adaptation to space and to develop physiological countermeasures to ensure crew health in space and on return to Earth. The purpose of this Discipline Plan is to provide a conceptual strategy for NASA's Life Sciences Division research and development activities in the comprehensive area of cardiopulmonary sciences. It covers the significant research areas critical to NASA's programmatic requirements for the Extended-Duration Orbiter, Space Station Freedom, and exploration mission science activities. These science activities include ground-based and flight; basic, applied, and operational; and animal and human research and development. This document summarizes the current status of the program, outlines available knowledge, establishes goals and objectives, identifies science priorities, and defines critical questions in the subdiscipline areas of both cardiovascular and pulmonary function. It contains a general plan that will be used by both NASA Headquarters Program Offices and the field centers to review and plan basic, applied, and operational (intramural and extramural) research and development activities in this area. Author

N93-19663# Queens Medical Centre, Nottingham (England). Dept. of Orthopaedic and Accident Surgery.

CAN INJURY SCORING TECHNIQUES PROVIDE ADDITIONAL INFORMATION FOR CRASH INVESTIGATORS?

J. M. ROWLES, W. A. WALLACE, and D. J. ANTON *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 10 p Sep. 1992
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The Abbreviated Injury Score (AIS) and Injury Severity Score were calculated for all passengers and crew of the M1 Kegworth aircraft crash. Regional scores were significantly higher in nonsurvivors than survivors of the impact. Mortality and ISSs were found to correlate with the structural damage sustained by the aircraft. The use of injury scoring has highlighted variations in the severity of injuries sustained by occupants involved in an impact aircrash. This information has demonstrated that other factors in addition to the force of the impact were involved in the causation of injury, such as structural integrity, attempts by occupants to protect adjoining passengers, being struck by loose objects and rear facing seats. Author

N93-19664# Queens Medical Centre, Nottingham (England). Dept. of Orthopaedic and Accident Surgery.

IS AXIAL LOADING A PRIMARY MECHANISM OF INJURY TO THE LOWER LIMB IN AN IMPACT AIRCRAFT ACCIDENT?

J. M. ROWLES, P. BROWNSON, W. A. WALLACE, and D. J. ANTON *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992
Copyright Avail: CASI HC A02/MF A04

Following the crash of a Boeing 737-400 aircraft on the M1 motorway near Kegworth, England, on 8 January 1989, it became apparent that a large number of pelvic and lower limb injuries had been sustained by the survivors. Had there been a fire this would have severely hindered the ability of the occupants to escape. The mechanism of pelvic and lower limb injuries in impact accidents has been related to failing of the limbs and axial loading of the femur. The validity of axial loading of the femur as a primary mechanism of femoral fracture in an impact aircraft accident is questioned. Two methods of study have been used to investigate the impact biomechanics of the pelvis and lower limb: clinical review and impact testing using anthropomorphic dummies. Our study suggests that in the presence of intact occupant protection systems, bending of the femur over the front spar of passenger seats is the primary mechanism of causation of femoral fractures. Occupant protection systems designed for civil aircraft should be modified to accommodate loading of the femur over the front of the seat. Author

N93-19683# *German Air Force, Fuerstenfeldbruk (Germany).*

EFFECTS OF MEDIUM BLOOD ALCOHOL LEVELS ON PILOTS' PERFORMANCE IN THE SEA KING SIMULATOR MK-41

M. KRAEMER *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 3 p Sep. 1992
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A number of 20 military pilots drank certain amounts of alcohol until the blood alcohol concentrations reached a level of about 0.8 o/oo. After that they had to fly an IFR mission using the flight simulator for 2 1/2 hours. They were told to perform the complete program of navigation and flight operations and also

communications with, for example, air traffic control (ATC). During the simulated flight programmed technical failures occurred concerning the instruments and the engine. The reactions of pilots and the cause were registered. The results were obtained by summarizing false reactions. Significant differences in the number of wrong reactions due to alcohol consumption were registered.
Author

N93-19694# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).
FIRES ON BOARD AIRCRAFT: TOXICOLOGICAL RISK IN FLIGHT [INCENDIES A BORD DES AERONEFS: RISQUE TOXICOLOGIQUE EN VOL]
M. KERGUELEN, M. MIGNET, and J. M. JOUANY *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 12 p Sep. 1992 In FRENCH
Copyright Avail: CASI HC A03/MF A04

At the time of fires on board aircraft, intoxication by the products of the thermolysis of the materials used in the installation of the cabin represents a major risk. To evaluate the toxic risk of fires on board aircraft in flight, it is necessary to take into account not only the ventilation but also the pressure of the cabin, which can vary between 1000 and 750, even 700 hPa. An original model fire was developed, making it possible to study, under ventilation conditions representative of an aircraft, the influence of the pressure on the thermolysis of various materials. Thermolysis was considered on physiochemical and toxicological levels, the mouse being chosen as the experimental animal. The study showed that the toxic risk varies considerably according to the material considered. In addition, under these experimental conditions, the barometric pressure drop from 1000 to 700 hPa hardly modified the physicochemical characteristics of the thermolysis of the majority of studied materials. On the other hand this pressure drop generally generated a very significant increase in toxicity of the generated gas mixture, in which carbon monoxide and/or hydrocyanic acid have a dominant share. Author

N93-19695# *German Air Force, Fuerstenfeldbruk (Germany).* Aviation Pathology Group.
TOXICOLOGICAL INVESTIGATIONS OF FLIGHT ACCIDETNS: FINDINGS AND METHODS
G. POWITZ *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 7 p Sep. 1992
Copyright Avail: CASI HC A02/MF A04

After accidents with fume in the cockpit a characteristic profile of pyrolysis products is gaschromatographically often detectable in the blood. This profile we have to distinguish from an inhalation of fuel or from a fasting blood. The sensitivity was improved. If carbonyl compounds are supposed in the biological materials, we identify them by the reaction with semicarbazide in the head space bottles of the gaschromatograph. From about 5 percent CO-Hb, we determine photometrically the cyanide level. After a fatal crash over the sea bromide-concentrations were found in the examination materials, which exceeded clearly the physiological area. All previous results with essential longer immersion-times in sea-water told against a contingent uptake of bromide from the sea. Experiments with animal and human lungs demonstrated, that we have to calculate with such an enrichment in biological materials yet. With this knowledge, a second pilot in an analogous case could be cleared from the suspicion of having abused bromine containing sedatives, too. In estimating from a corpse, we ascertained gaschromatographically distinct higher values than with the enzymatic method. Further examinations showed that, caused by bacterial putrefaction, an alcohol formation occurred during the sample preparation. Any alcohol concentrations in the elder literature have to be regarded under a new aspect after that. In some investigations of dead pilots we identified hypnotics. In one case it succeeded to determine the time of intake with the more unspecific thin-layer chromatography instead of mass spectrometry. According to that, the extraction procedures became modified. The different used extraction methods for the single drug categories will be compared. Author

N93-19696# German Air Force, Fuerstenfeldbruk (Germany). Aerospace Pathology and Toxicology.
27 YEARS ARMED FORCES AEROSPACE PATHOLOGY AND TOXICOLOGY IN THE FEDERAL REPUBLIC OF GERMANY: DEVELOPMENT, CURRENT STATUS, TRENDS AND CHALLENGES
B. MAYR, G. APEL, and M. KRAEMER *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 3 p Sep. 1992
Copyright Avail: CASI HC A01/MF A04

The west German armed forces Aerospace Pathology and Toxicology was founded in April 1964 as a division of the German Airforce Institute of Aerospace Medicine. Prof. S. Krefft was assigned the development of this division in a time of increasing accident rates due to the so-called 'F-104 G Starfighter crisis'. Krefft developed the concept of a mobile, airborne investigation and autopsy team with centralized laboratories for identification, histopathology and toxicology at Furstenfeldbruck AFB, near Munich. Though the doctors of the autopsy team normally are addressed as pathologists, they are in fact forensic pathologists, thereby meeting the requirements of German law. Trends in accidents and incidents are evaluated and discussed with respect to future developments. New methods and techniques are presented such as DNA-based identification. Author

N93-19697# German Air Force, Fuerstenfeldbruk (Germany). Aerospace Pathology and Toxicology.
SIGNIFICANCE OF HISTOLOGICAL POSTMORTEM FINDINGS IN PILOTS KILLED IN MILITARY AND CIVIL AIRCRAFT ACCIDENTS IN GERMANY (WEST): A 25-YEAR-REVIEW
M. KRAEMER and U. STOCKER *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 5 p Sep. 1992
Copyright Avail: CASI HC A01/MF A04

The Division of Aerospace Pathology and Toxicology ('Flugunfallmedizin') at the German Air Force Aerospace Medical Institute was founded in 1964 by Col. Prof. Krefft and is since then located at Furstenfeldbruck AFB near Munich. The Division is engaged in the medical and medico-legal part of all fatal accident - most non fatal accident - and incident investigations concerning German military aircraft (Airforce, Navy and Army). The Division performs also some civilian medical accident investigations for the Federal Aviation Administration ('FUS, Flugunfall Untersuchungsstelle beim Luftfahrt Bundesamt'). The autopsy files of the period 1 January 1965 up to 31 December 1990 were reviewed. In 231 civilian and military crashes a total of 455 autopsies was performed, resulting in 385 valid autopsy reports of killed pilots including a histopathological examination. Histopathological findings were coded and stored in a data base of an IBM compatible computer. In those cases with positive histopathological findings in the files the tissue was reexamined. 36 cases showed severe histopathological alterations. 21 of these might be considered to have reduced physical and/or mental performance and thus have affected the capability of flight safety. A selection of ten cases is used to discuss problems of accident causality in case of positive histopathological findings. The value and validity of findings especially in those cases of a high degree of tissue destruction is demonstrated. In aircraft accident investigations autopsy and histopathological examination must - on the basis of nearly 5 percent positive histopathological findings - be regarded as mandatory. Author

N93-19698# Hellenic Air Force General Hospital, Athens (Greece).
AIRCRAFT ACCIDENT INJURIES IN THE HELLENIC AIR FORCE IN THE LAST 20 YEARS
ODYSSEAS PAXINOS *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 4 p Sep. 1992
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Military flying is a dangerous activity and safety is a major concern. Post accident pathology is an essential tool of determining the cause of death of the pilot, types of injuries, possible physiological problems that contributed to the accident and finally,

possible solutions to improve safety. The aircrew injuries of 151 Class-A accidents, of the Hellenic Air Force, in the last 20 years is presented. Accidents were divided, according the aircraft type, in three groups: Jet Aircraft Accidents, Fixed Wing Props Accidents and Helicopter Accidents. In the Jet Aircraft group, a subdivision was made in three more subgroups: Non ejection attempted, successful ejection and unsuccessful ejection. In all groups the type and location of injuries was recorded, and the results were discussed. An attempt was made to give possible solutions. Injury data bank of aircraft accidents can be very useful in improving accident investigation techniques and safety and more data must be recorded. Author

N93-19707# Paris V Univ. (France).
STUDY OF THE SPECTRUM OF POWER OF CARDIAC RHYTHM DURING TASKS RELATING TO THE SAFETY OF THE CONTROL OF AN APPARATUS [ETUDE DU SPECTRE DE PUISSANCE DU RYTHME CARDIAQUE AU COURS DE TACHES RELATIVES A LA SECURITE DE LA CONDUITE DE L'APPAREIL]
J. P. FOUILLOT, M. BENAOUDIA, P. CABON, A. BENHALLA, and A. COBLENTZ *In* AGARD, *Aircraft Accidents: Trends in Aerospace* Medical Investigation Techniques 1 p Sep. 1992 In FRENCH
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The relaxation of attention to this subject increases the probability of the occurrence of minor errors of which the absence of detection and the accumulation are likely to lead to an incident. Mulder, Vicente, Morey and other authors showed the interest of the study of the spectrum of the power of cardiac rhythm, and more particularly of the frequency band 0.05 - 0.15 Hz in the evaluation of the mental effort of the subject. We have previously shown the existence of a correspondence between measurements of cardiac variability in the temporal field, and the subjective evaluation of the workload of the pilot. This is primarily a mental workload whose main components are the pressure of time, stress and mental effort. We continued this study of the cardiac rhythm of the pilot, in the frequential field, and development of a program to analyze the power spectrum of the heart rate taking into account the limits of studying a discrete signal. The recording of the heart rate is carried out by means of an ambulatory monitoring system and is associated with synchronous observation of the activity of the subject. This method was applied to measurements carried out during psychophysiological tests in the laboratory and during real situations of the piloting of various aircraft. The results obtained show the sensitivity of the spectral energy of the cardiac rhythm in the frequency band 0.05 - 0.15 Hz, to the mental effort of the subject. However, the spectral energy in this frequency band is not correlated with the difficulty of the task, nor with the performance. Certain subjects slacken their mental effort when the difficulty of the task appears excessive to them, others maintain it or increase it without improving their performance. The increase or absence of reduction in the spectral energy of the cardiac rhythm when facing a task of increased difficulty, or during tasks relating to the safety of the piloting of the aircraft, could constitute a factor which leads to error and increases the probability of incident or accident. Author

N93-19708# Regie RENAULT, Nanterre (France).
CONTRIBUTION OF THE ANALYSIS OF OCULAR ACTIVITY (COMPLEMENTARY TO THE ELECTROENCEPHALOGRAPHIC ANALYSIS) TO THE DETECTION OF LOW VIGILANCE IN INSTANCES OF PILOTING A VEHICLE [CONTRIBUTION DE L'ANALYSE DE L'ACTIVITE OCULAIRE (COMPLEMENTAIRE DE L'ANALYSE ELECTROENCEPHALOGRAPHIQUE) A LA DETECTION DES BAISSES DE VIGILANCE DANS LES TACHES DE PILOTAGE DE VEHICULE]
C. TARRIERE, S. PLANQUE (Association pour la Recherche Interessant la Medicine du Travail, Paris, France), C. CHABANON (Regie RENAULT, Aubevoye, France), P. ARTAUD (Association pour la Recherche Interessant la Medicine du Travail, Paris, France), and C. LAVERGNE (Association pour la Recherche Interessant la Medicine du Travail, Paris, France) *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992 In FRENCH
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The Department of Environmental Sciences of RENAULT studies a system of detection of the drops in vigilance of the driver. Installed in the vehicle, this has as its role the prevention of any deterioration in the state of vigilance of the driver. The principle is based on the analysis in real time of the movements which the driver imposes on his wheel. The design of such a system requires, in a study phase, the knowledge at any moment of the level of vigilance of the subject from physiological signals, in order then to determine the parameters of the Flying Angle signal which will be ready to substitute itself there in order to distinguish two states of vigilance. We present here a method allowing the definition of a physiological reference of the level of vigilance of the driver, based on the approach complementary to electroencephalography (EEG), electrooculography (EOG) and on behavioral analysis by video imagery. The trend analysis of the oculographic diagrams significantly improves the early detection of hypo-vigilance. Thanks to the knowledge of this physiological reference, we now have the results obtained on the Flying Angle signal in terms of detection of hypo-vigilance. Author

N93-19710# Gulhane Skeri Tip Akademisi, Eskisehir (Turkey). Aerospace Medical Center.
EFFECTIVENESS OF BIRTHDATE BIORHYTHM THEORY ON FLIGHT ACCIDENTS
MUZAFFER CETINGUC, UMIT SARYKAYALAR (Gulhane Skeri Tip Akademisi, Ankara, Turkey), and KEMAL SAVASAN (Gulhane Skeri Tip Akademisi, Ankara, Turkey) *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 6 p Sep. 1992
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Birthdate Biorhythm Theory presents a daily guideline to people about the time of their highest and lowest performance. The theory is that it is possible to estimate in which days physical, intellectual or emotional success or failure would happen. The results reached by this investigation, in short, is that popular birthdate biorhythm theory is not capable of explaining the aircraft accidents. Ideal minimum level can be reached by objective and cautious inspections in order to decrease the accidents. The most important conditions in this is to consider the reasons and precautions from scientific perspective. It may be interesting to approach by simple method requiring scientific discussion but one must not fall in its traps. I.I.C.

N93-19838# Oak Ridge Associated Universities, Inc., TN.
HEALTH EFFECTS OF LOW-FREQUENCY ELECTRIC AND MAGNETIC FIELDS
Jun. 1992 379 p
(Contract DE-AC05-76OR-00033)
(DE93-005675; ORAU-92/F8) Avail: CASI HC A17/MF A03

The US Department of Labor and the President's Office of Science and Technology Policy (STP) requested that the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) conduct an independent evaluation of the reported health effects from exposure to low-frequency electric and magnetic fields (ELF-EMF), especially reports of carcinogenesis and reproductive and neurophysiological effects focusing on frequencies which appeared to be of greatest public concern. Oak Ridge Associated Universities (ORAU) was tasked by the CIRRPC to oversee the review by a panel of independent, non-Federal, scientists. Following their review of over 1000 journal articles, the ORAU Panel concluded ... that there is no convincing evidence ... to support the contention that exposure to ELF-EMF generated by sources such as household appliances, video display terminals (10 to 30 KHz), and local power lines (15 to 180 Hz) are demonstrable health hazards. Although the Panel noted that some biological effects produced by these fields may be of scientific interest and warrant consideration for future research, it concluded that ... in the broad scope of research needs in basic science and health research, any health concerns over exposures to these fields should not receive a high priority. DOE

N93-19882*# National Aeronautics and Space Administration, Washington, DC.
NEUROSCIENCE DISCIPLINE SCIENCE PLAN
1991 25 p
(NASA-TM-108041; NAS 1.15:108041) Avail: CASI HC A03/MF A01

Over the past two decades, NASA's efforts in the neurosciences have developed into a program of research directed at understanding the acute changes that occur in the neurovestibular and sensorimotor systems during short-duration space missions. However, the proposed extended-duration flights of up to 28 days on the Shuttle orbiter and 6 months on Space Station Freedom, a lunar outpost, and Mars missions of perhaps 1-3 years in space, make it imperative that NASA's Life Sciences Division begin to concentrate research in the neurosciences on the chronic effects of exposure to microgravity on the nervous system. Major areas of research will be directed at understanding (1) central processing, (2) motor systems, (3) cognitive/spatial orientation, and (4) sensory receptors. The purpose of the Discipline Science Plan is to provide a conceptual strategy for NASA's Life Sciences Division research and development activities in the comprehensive area of neurosciences. It covers the significant research areas critical to NASA's programmatic requirements for the Extended-Duration Orbiter, Space Station Freedom, and exploration mission science activities. These science activities include ground-based and flight; basic, applied, and operational; and animal and human research and development. This document summarizes the current status of the program, outlines available knowledge, establishes goals and objectives, identifies science priorities, and defines critical questions in the subdiscipline areas of nervous system function. It contains a general plan that will be used by NASA Headquarters Program Offices and the field centers to review and plan basic, applied, and operational intramural and extramural research and development activities in this area.
Author

N93-19892*# National Aeronautics and Space Administration, Washington, DC.
MUSCULOSKELETAL DISCIPLINE SCIENCE PLAN
1991 34 p
(NASA-TM-108039; NAS 1.15:108039) Avail: CASI HC A03/MF A01

Life sciences research in the musculoskeletal discipline must identify possible consequences of weightlessness on this system, understand the mechanisms of these effects, and develop effective and operationally practical countermeasures to protect crewmembers. The musculoskeletal system is highly plastic in that is possesses the inherent capability to adapt its structural and functional properties in accordance with the type and degree of stimuli imposed on it. Prolonged space travel is essentially a period of significant unloading of the musculoskeletal system. This results in adaptive responses in the structure and function of this system, placing it on the low end of a continuum from one of complete disuse to one of maximal use. There is a high probability that the musculoskeletal system is functionally impaired with increasing duration of weightlessness. The purpose of this Discipline Science Plan is to provide a conceptual strategy for NASA's Life Sciences division research and development activities in the area of musculoskeletal function. This document summarizes the current status of the program, outlines available knowledge, establishes goals and objectives, identifies science priorities, and defines research opportunities, which encompass critical questions in the subdiscipline areas (e.g., muscle, bone, and other musculoskeletal connective tissues). These science activities include ground-based and flight; basic, applied, and operational; and animal and human research and development. This document contains a general plan that will be used by both NASA Headquarters Program Offices and the field centers to review and plan basic, applied, and operational intramural and extramural research and development activities in this area.
Author

N93-20303*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RADIOLOGICAL ASSESSMENT FOR SPACE STATION FREEDOM
GAUTAM D. BADHWAR, ALVA C. HARDY, DONALD E. ROBBINS, and WILLIAM ATWELL (Rockwell International Corp., Houston, TX.) Jan. 1993 14 p
(NASA-TM-104758; S-703; NAS 1.15:104758) Avail: CASI HC A03/MF A01

Circumstances have made it necessary to reassess the risks to Space Station Freedom crewmembers that arise from exposure to the space radiation environment. An option is being considered to place it in an orbit similar to that of the Russian Mir space station. This means it would be in a 51.6 deg inclination orbit instead of the previously planned 28.5 deg inclination orbit. A broad range of altitudes is still being considered, although the baseline is a 407 km orbit. In addition, recent data from the Japanese A-bomb survivors has made it necessary for NASA to have the exposure limits reviewed. Preliminary findings of the National Council on Radiation Protection and Measurements indicate that the limits must be significantly reduced. Finally, the Space Station will be a laboratory where effects of long-term zero gravity on human physiology will be studied in detail. It is possible that a few crewmembers will be assigned to as many as three 1-year missions. Thus, their accumulated exposure will exceed 1,000 days. Results of this radiation risk assessment for Space Station Freedom crewmembers finds that females less than 35 years old will be confined to mission assignments where the altitude is less than about 400 km. Slight restrictions may also need to be made for male crewmembers less than 35 years old.
Author

N93-20318*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EFFECT OF AEROBIC CAPACITY ON LOWER BODY NEGATIVE PRESSURE (LBNP) TOLERANCE IN FEMALES
ALAN D. MOORE, JR. (Krug Life Sciences, Inc., Houston, TX.), SUZANNE M. FORTNEY, and STEVEN F. SICONOLFI Washington Mar. 1993 14 p
(NASA-TP-3298; S-695; NAS 1.60:3298) Avail: CASI HC A03/MF A01

This investigation determined whether a relationship exists in females between: (1) aerobic capacity and Lower Body Negative Pressure (LBNP); and (2) aerobic capacity and change in LBNP tolerance induced by bed rest. Nine females, age 27-47 (34.6 plus or minus 6.0 (Mean plus or minus SD)), completed a treadmill-graded exercise test to establish aerobic capacity. A presyncopal-limited LBNP test was performed prior to and after 13 days of bed rest at a 6 deg head-down tilt. LBNP tolerance was quantified as: (1) the absolute level of negative pressure (NP) tolerated for greater than or equal to 60 sec; and (2) Luft's Cumulative Stress Index (CSI). Aerobic capacity was 33.3 plus or minus 5.0 mL/kg/min and ranged from 25.7 to 38.7. Bed rest was associated with a decrease in NP tolerance (-9.04 1.6 kPa(-67.8 plus or minus 12.0 mmHg) versus -7.7 1.1 kPa(-57.8 plus or minus 8.33 mmHg); $p = 0.028$) and in CSI (99.4 27.4 kPa min(745.7 plus or minus 205.4 mmHg min) versus 77.0 16.9 kPa min (577.3 plus or minus mmHg min); $p = 0.008$). The correlation between aerobic capacity and absolute NP or CSI pre-bed rest did not differ significantly from zero ($r = -0.56$, $p = 0.11$ for NP; and $r = -0.52$, $p = 0.16$ for CSI). Also, no significant correlation was observed between aerobic and pre- to post-rest change for absolute NP tolerance ($r = -0.35$, $p = 0.35$) or CSI ($r = -0.32$, $p = 0.40$). Therefore, a significant relationship does not exist between aerobic capacity and orthostatic function or change in orthostatic function induced by bed rest.
Author

N93-20384# Army Research Inst. of Environmental Medicine, Natick, MA.
NUTRITION AND HYDRATION STATUS OF AIRCREW MEMBERS CONSUMING THE FOOD PACKET, SURVIVAL, GENERAL PURPOSE, IMPROVED DURING A SIMULATED SURVIVAL SCENARIO Final Report, Jun. 1991 - Nov. 1992
TANYA E. JONES, SUSAN H. MUTTER, JUDY M. AYLWARD,

JAMES P. DELANY, and ROBERT L. STEPHENS Nov. 1992 126 p
(Contract DA PROJ. 3M2-63002-D-819)
(AD-A258744; USARIEM-T1-93) Avail: CASI HC A07/MF A02

Adequate nutrition and hydration can be crucial to the survival of downed aircrews. To determine the nutritional adequacy and palatability of an improved, all-purpose, all-environment survival packet (GP-I) compared to the old survival packet (GP), a field test was conducted using combat survival school students. During a five day survival exercise, 41 aircrew member's ate the GP-I and 57 ate the GP. Nutrition/hydration status were assessed from food/fluid intake records as well as changes in body weight. Water turnover was measured in a subset of subjects (n=30) using deuterium oxide. Pre- and posttest hemoglobin, hematocrit plasma osmolality, urine specific gravity (SG) and ketones were also measured. Acceptability of the two rations was evaluated. Subjects eating the GP-I consumed more Calories; GP-I 774+/-436 vs GP 642+/-408 kcal/d. Carbohydrate and protein consumption were similar but the GP-I group ate significantly more fat, 35+/-21 vs 24+/-18 g/d. Mean fluid intake was similar for both groups (GP-I 4.3+/-1.7, GP 4.4+/-1.9 L/d). Sodium intakes were 1.6 g/d. Weight decreased significantly for the GP-I and GP groups (2.9+/-1.4, 3.4+/-1.7 kg, respectively); changes were similar between groups. Water turnover data indicated subjects maintained adequate hydration as did hemoglobin, hematocrit, and plasma osmolality. Mean posttest urine SG was 1.024-/+0.007 and moderate amounts of ketones were detected. Both rations received favorable ratings, but the greater variety of the GP-I ration resulted in higher acceptability ratings for this ration. We conclude from these results that either ration is adequate, however, the variety and palatability of the GP-I is more desirable than He GP. GRA

N93-20400# Army Aeromedical Research Lab., Fort Rucker, AL.
EFFECTS OF MICROCLIMATE COOLING ON PHYSIOLOGY AND PERFORMANCE WHILE FLYING THE UH-60 HELICOPTER SIMULATOR IN NBC CONDITIONS IN A CONTROLLED HEAT ENVIRONMENT Final Report, May 1991 - May 1992
ROBERT J. THORNTON, LYNN CALDWELL, FRANK GUARDIANI, and JACKIE PEARSON Aug. 1992 250 p
(AD-A258502; USAARL-92-32) Avail: CASI HC A11/MF A03

The effects of microclimate cooling on aviator performance and physiology in nuclear, biological, and chemical (NBC) individual protective equipment (IPE) were evaluated in the USAARL UH-60 research flight simulator. Sixteen male aviators flew the simulator in two temperature conditions, 95 F and 105 F, both at 50 percent relative humidity (RH). Two thermoelectric conditioning units were used, one providing cooled blown air, the other cooled water to the aviators. At each temperature, they flew for up to 6 hours in NBC IPE with no cooling, air cooling, and liquid cooling. There was an extra condition at 105 F when vent air with no cooling was blown through the air vest, making a total of seven test conditions. There were significant improvements in flight performance as a result of the cooling, more so at the higher temperature. Also, there were differences between the two cooling systems at 105 F, with the air system producing significantly lower flight error rates. Survival time was based on the length of time each subject stayed in the condition before reaching physiological withdrawal criteria (rectal temperature of 39 C or heart rate of 150 beats per minute for 15 minutes) or exercising their option to retire early. There were considerable increases in survival time with the use of microclimate cooling. The mean survival time at 95 F was increased to 385 minutes with the liquid system from 285 minutes without cooling. At 105 F to 333 minutes for the air system from 79 minutes with no cooling, the improvement was even more dramatic. There were significant differences between the two cooling systems at 105 F with the air system producing longer survival times. GRA

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BEHAVIORAL SCIENCES

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

A93-21870
EFFECTS OF SLEEP DEPRIVATION ON THE COGNITIVE CAPACITIES OF VISUO-SPATIAL REPRESENTATION AND ORIENTATION [EFFETS D'UNE PRIVATION DE SOMMEIL SUR LES CAPACITES COGNITIVES DE REPRESENTATION VISUO-SPATIALE ET D'ORIENTATION]
C. CIAN, P. A. BARRAUD, D. POQUIN, and C. RAPHEL (Service de Sante des Armees, Centre de Recherches, La Tronche, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541) no. 18 4th Quarter, 1992 p. 139-144. In French. refs
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An experiment was conducted to investigate the evolution of mental representation and spatial orientation abilities during 60 hours of sleep deprivation. It is shown that mental imagery activity is slowed down by sleep loss but manipulation of memorized images is not altered. There is a reinforcement of the cognitive style of orientation observed in normal conditions, which is manifested in a decrease in the fineness of mental discrimination relative to different information sources. L.M.

A93-23150
PSYCHOPHYSIOLOGICAL FACTORS WHICH IMPAIR THE PROFESSIONAL RELIABILITY OF A PILOT IN EMERGENCY SITUATIONS [PSIKHOFIZIOLOGICHESKIE FAKTORY, SNIZHAIUSHCHIE PROFESSIONAL'NUIU NADEZHNOST' LETCHIKA V AVARIINYKH SITUATSIIAKH]
V. V. KOZLOV, A. G. FEDORUK, and V. V. SHCHERBINSKII Voenno-Meditsinskii Zhurnal (ISSN 0026-9050) no. 11 Nov. 1992 p. 60-63. In Russian.
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The main psychophysiological causes of the decreased performance of pilots during emergency situations created by instrument or mechanical breakdowns during flight were investigated using results of a study of helicopter pilots whose psychophysiological parameters were measured during normal flight and in emergency situations. It was found that an expectation of a breakdown by an insufficiently trained pilot does not necessarily improve his performance during the breakdown. The rate of adaptation of a pilot to emergency situations created by mechanical breakdowns is determined by the level of the pilot's experience (i.e., his ability to recognize the situation). I.S.

A93-23693
THE TRAINING OF THE NEW ASTRONAUT CANDIDATES AT EAC
K. DAMIAN (ESA, European Astronauts Centre, Cologne, Germany) ESA Bulletin (ISSN 0376-4265) no. 72 Nov. 1992 p. 83-87.
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The first training activities to be undertaken at the European Astronauts Centre have recently been completed, with five new European astronaut candidates receiving an intensive introduction to ESA, the European space programs, and basic space science and technology. The instructors for these first courses, given in June and July, were a mixture of key ESA personnel and recognized experts from universities and scientific institutes prominent in the space field, as well as experienced astronauts. Author

A93-24040
SAFETY CONCERNS AS A FACTOR IN PILOT DESIRE TO CHANGE AIRCRAFT
TIMOTHY J. UNGS (USCG, Kodiak, AK) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan.

1993 p. 20-23. refs
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An anonymous and voluntary questionnaire was completed by 461 Coast Guard aviators at 26 participating Air Stations. Most pilots felt that helicopters had more dangerous missions and were less safe than fixed wing aircraft (FXAC). Two thirds of helicopter and 19.3 percent of FXAC pilots stated a desire to change to a different aircraft category. Only 1 of the FXAC pilots but 81 of the helicopter pilots stated their wish for aircraft change was influenced by a desire to operate aircraft they perceived as safer. Pilots who desired change in aircraft category were more senior, more experienced, and felt they were currently engaging in dangerous flight operations. In conclusion this study found that: Coast Guard pilots consider helicopters less safe than FXAC; a substantial proportion of helicopter pilots would like to change to FXAC; and safety concerns can be a common factor in pilots' desires to change aircraft. Author

A93-25205
THE EFFECT OF G-LOC ON PSYCHOMOTOR PERFORMANCE AND BEHAVIOR
ESTRELLA M. FORSTER and JOSEPH P. CAMMAROTA (U.S. Navy, Naval Air Warfare Center, Warminster, PA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 132-138. refs
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The effect of G-induced loss of consciousness (G-LOC) on the cognitive and motor performance and behavior was investigated in experiments where human subjects were exposed to closed-loop acceleration in a human centrifuge. The +Gz profile consisted of several aerial combat environment simulations (ACESs) of up to +12 Gz; psychomotor performance was measured before, immediately after, and 20-40 min post-G-LOC, using results of three different tasks. It was found that the time intervals to execute the performance tasks were longer for post-G-LOC than for pre-G-LOC. No performance decrements were observed to occur during tasks assigned 20-40 min after G-LOC. I.S.

A93-25207
PRELIMINARY ANALYSIS OF SENSORY DISTURBANCES AND BEHAVIORAL MODIFICATIONS OF ASTRONAUTS IN SPACE
C. TAFFORIN and M. LAMBIN (Toulouse III, Univ., France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 146-152. Research supported by CNES and CNRS refs
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Behavioral modifications of astronauts over time spent in microgravity conditions was investigated according to an ethological approach based on video recordings during the Spacelab-1 mission. The method consisted of a description and a quantification of motor activity of a subject (movement and orientation) while performing working tasks. Each period of observation lasted 20 min, or days 1, 2, 3, 4, 7, 9, and 10. This provided a rather consistent frequency for behavioral sampling. The data were correlated with the findings of physiological experiments performed during the same spaceflight. Results revealed an increase in frequencies of certain motor outputs (e.g., yaw head and body movements, hand gripping, feet anchoring) which favored several specific sensory inputs (visual and tactile information). In addition to the appearance of head-down orientations while manipulating floating objects and during periods of body free-floating, the astronaut developed a new representation of the space and the objects around him in microgravity. These behavioral interpretations are discussed in the light of sensorimotor interactions and cognitive events. Author

A93-25209
MEASURING PERFORMANCE DECREMENTS IN AVIATION PERSONNEL INFECTED WITH THE HUMAN IMMUNODEFICIENCY VIRUS
ROBERT L. MAPOU (Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD), GARY G. KAY (Georgetown Univ., Washington), JAMES R. RUNDELL (U.S. Army, Walter Reed Inst. of Research, Washington), and LYDIA TEMOSHOK (Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 2 Feb. 1993 p. 158-164. refs
(Contract DAMD17-88-Z-8807)
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There is controversy over whether cognitive impairment occurs in early human immunodeficiency virus (HIV) disease. When impairment is reported, findings are typically subclinical, affect only a minority, and their relationship to occupational functioning has not been established. Despite such findings, it has been recommended that HIV-seropositive pilots be disqualified from flying. This paper reviews research relevant to measuring performance decrements in HIV-infected aviators. Based upon current data, we conclude that although subtle neurobehavioral dysfunction may occur in some asymptomatic HIV-seropositive individuals, there is no research which has demonstrated associated decrements in aviation-related skills. Thus, it may be premature to recommend medical disqualification of all HIV-seropositive aviators. We propose, instead, that sensitive neurocognitive measures, incorporated into a comprehensive neurodiagnostic evaluation, could be used to evaluate asymptomatic HIV-seropositive aviators. Only those who are impaired on evaluation would be disqualified from flying. Concurrently, research investigating the relationship between abnormalities and aviation abilities would be conducted. Author

N93-17816# Washington Univ., Saint Louis, MO. Dept. of Psychology.
ENHANCED PERFORMANCE USING PHYSIOLOGICAL FEEDBACK Final Technical Report, 28 May 1987 - 27 Nov. 1990
JOHN A. STERN, ROBERT GOLDSTEIN, and RICHARD DOBKIN Oct. 1992 52 p
(Contract F33615-87-C-0603)
(AD-A258006; AL-TP-1992-0018) Avail: CASI HC A04/MF A01

Four studies are described designed to investigate (1) the use of blink variables to predict errors in vigilance performance, (2) the relationship between blink latency and decision making, (3) the factors affecting blink latency in a cognitive task, and (4) head and eye movements in acquiring peripheral information. In the first experiment, blinks were not found to be associated with error stimuli any more than they were with correct stimuli. The second experiment investigated the hypothesis that blink latency following a discriminative stimulus is a function of the time at which the decision could be made. Blink latency varied with the duration of the target stimulus, confirming the hypothesis. The third study investigated factors influencing the reduction in blink latency over trials. Components of the response sequence were isolated experimentally. Results suggested that the reduction in blink latency is due to an improvement in the implementation of the instructional rule. In the final study, head and eye movements were studied while subjects responded to peripheral stimuli. The proportion of the gaze shift accomplished by a head movement increased with task difficulty. Also, prior information about the time required by the task affected saccade latency to the peripheral stimulus. GRA

N93-17820# Boston Univ., MA. Center for Adaptive Systems.
THE COGNITIVE, PERCEPTUAL, AND NEURAL BASES OF SKILLED PERFORMANCE Annual Technical Report, 15 Mar. 1991 - 14 Mar. 1992
STEPHEN GROSSBERG Sep. 1992 66 p
(Contract AF-AFOSR-0175-90)
(AD-A258236; AFOSR-92-0976TR) Avail: CASI HC A04/MF A01

This report reviews progress from the Boston University, Northeastern University, and Harvard University/Cambridge University research groups of our AFOSR University Research Initiative grant. The report lists books and articles, summaries of research, and selected abstracts of key articles. The report also includes the program of an AFOSR-supported neural networks course and conference that were held at the Wang Institute of

Boston University on May 5-12, 1991. The topic of the course was Neural Networks: From Foundations to Applications. Thirty-one lectures were given by ten lecturers. AFOSR helped to subsidize the student attendees. The topic of the conference was Neural Networks for Vision and Image Processing. There were sixteen invited speakers and forty-one contributed posters. Three hundred scientists and students attended from around the world. This conference was published as a book of the same name by the MIT Press in 1992. The Editorial Preface of the book is enclosed. The colloquium series speakers and topics of the Boston University URI component are also enclosed. GRA

N93-17857# Aerospace Medical Research Labs., Brooks AFB, TX.
FLIGHT DIRECTOR INFORMATION AND PILOT PERFORMANCE IN INSTRUMENT APPROACHES Final Report, Apr. 1988 - Mar. 1991
REBECCA B. BROOKS, HARRY D. WARNER, DAVID C. HUBBARD, WILLIAM E. LINCOLN, and GRETCHEN M. KRUEGER-ANDERSON Aug. 1992 72 p
(Contract AF PROJ. 1123)
(AD-A258186; AL-TR-1992-0066) Avail: CASI HC A04/MF A01

This report documents the results of a research effort conducted to identify problem areas encountered during instrument approaches and landings in an F-16A through adverse meteorological conditions. Phase 1 consisted of identification and simulation of visual conditions likely to produce the conflict/misorientation experienced under 'real-world' conditions and development of performance measurement standards for F-16A instrument landing system (ILS) training. During phase 2, an experiment was conducted using the F-16A flight simulator at the Aircrew Training Research Division of the Armstrong Laboratory (AL/HRA) to evaluate F-16A pilot performance with five different ILS instrument configurations: (1) Head-up display (HUD) with flight director; (2) HUD without flight director; (3) panel instruments only; (4) panel instruments and head-down flight director; and (5) HUD with flight director, head-down flight director, and panel instruments. Normal aircraft configuration includes an ILS HUD display with flight director and cockpit panel instruments with raw ILS information. The head-down display, not found on the F-16A aircraft, was developed solely for the research. The display consisted of a head-down flight director that displayed computed steering commands from the HUD on the radar electro-optical display (REO). Twenty F-16A pilots with diverse levels of experience participated in this effort. Each pilot received 5 min of free flight and three practice approaches under benign visual flight rules (VFR) weather conditions. The pilot then flew 15 approaches (three under each condition, counterbalanced) under more difficult visual weather conditions which included scattered clouds, 1.5 mile-visibility, a 6000-ft ceiling, and a 15-knot crosswind. GRA

N93-17919# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE EFFICACY OF BIOGRAPHICAL INVENTORY DATA IN PREDICTING EARLY ATTRITION IN NAVAL AVIATION OFFICER CANDIDATE TRAINING Interim Report, Jun. 1987 - Jan. 1990
DAVID R. STREET, JR. and DANIEL L. DOLGIN Aug. 1992 14 p
(Contract NR PROJ. M00-96)
(AD-A258025; NAMRL-1373) Avail: CASI HC A03/MF A01

Attrition in the training of U.S. naval aviation officer candidates represents a historic problem. The early identification of those likely to attrite during training would significantly reduce overall training expenditures. In this study, we assessed the value of biographical information for predicting early attrition at the indoctrination level of naval aviation officer training. We selected a random sample of 1551 aviation officer candidates and naval aviation cadets for analysis. The subjects selected had taken the Aviation Selection Test Battery (ASTB) between 1987 and 1990 and had completed the aviation indoctrination program operated by the Naval Aviation Schools Command in Pensacola, Florida. A principal component factor analysis of Biographical Inventory items was conducted with those who passed (N = 1176) and also with those who attrited (N = 375) basic aviation indoctrination. The resultant factors were then forced into a discriminant function analysis to determine if the factors obtained were different for the two groups. We found that the factors were significantly different for the two groups. The results indicate that biographical data may be useful in identifying candidates who are most likely to attrite early from naval aviation training. GRA

N93-17921# Rice Univ., Houston, TX.
COMPARING PERFORMANCE ON IMPLICIT MEMORY TESTS Final Technical Report, Aug. 1991 - Aug. 1992
HENRY L. ROEDIGER, III 30 Sep. 1992 37 p
(Contract AF-AFOSR-0253-91)
(AD-A258168; AFOSR-92-0928TR) Avail: CASI HC A03/MF A01

AFOSR Grant 91-0253 supported four different lines of research, described herein. These are (1) a preliminary experiment to clarity our testing procedures; (2) experiments designed to examine effects of various types of repetition on several memory tests; (3) experiments designed to examine the effect of distinctive events on these tests; and (4) experiments designed to examine inhibition and spontaneous recovery in memory. The progress made on each topic is described. Briefly, all four lines of work have been carried to a successful completion, although in two cases (2 and 4) data are still being analyzed. Several publications from this research are either being published, written, or planned. GRA

N93-18027# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
DUAL-TASK TRAINING STRATEGIES AND AGING M.S. Thesis
HEATHER L. PRINGLE 1992 107 p
(AD-A258261; AFIT/CI/CIA-92-084) Avail: CASI HC A06/MF A02

The goal of this study was to examine whether or not variable priority training could be effectively used by the older population to improve performance on dual-tasks and whether or not this training transfers to different levels of complexity as well as to different tasks. The objective of variable priority training is to maintain the context of the complete task, while manipulating emphasis on each of the subtasks as a function of online feedback and experimenter instructions. Twenty-four subjects (ages 61 to 79) participated in ten sessions. Random assignment to either variable priority training (VP) or fixed priority training (FP) did not produce a gender balance. That non-withstanding, the results indicate that VP subjects had initial performance decrements related to the cost of learning a VP strategy. Once the strategy was mastered, however, VP subjects displayed learning where FP subjects did not. In transferring to new difficulty levels, no training advantages were evident. Variable priority training showed benefits in performance on novel tasks or novel additions to a learned task. GRA

N93-18205# Naval Aerospace Medical Research Lab., Pensacola, FL.
AN ANALYSIS OF A SUSTAINED FLIGHT OPERATION TRAINING MISSION IN NAVY ATTACK AIRCRAFT
C. A. DEJOHN and G. G. REAMS Jun. 1992 16 p
(Contract NR PROJ. M00-96)
(AD-A258199; NAMRL-1370) Avail: CASI HC A03/MF A01

As part of a sustained flight operations (SUSOPs) research project, we had an opportunity to evaluate the performance of aircrews from three squadrons attached to Carrier Air Wing (CAW) 15. These squadrons were involved in a practice, long-range, overwater, strike mission from the USS CARL VINSON (CVN-70). At that time, the CARL VINSON was underway from Pearl Harbor, Hawaii, to Alameda, California. The purpose of this investigation was to evaluate performance changes during the simulated SUSOP. Pre- and postmission performance was compared using t tests, at the 95% confidence level. Results showed a significant improvement in the ability to perceive noise-degraded speech and a significant increase in carrier landing scores. No changes were found in cognitive performance on a computerized performance assessment battery (PAB). GRA

N93-18273# Dayton Univ., OH. Research Inst.
AUTOMATIC INFORMATION PROCESSING AND HIGH PERFORMANCE SKILLS Final Report, Aug. 1988 - Jun. 1992
F. T. EGGEMEIER and ARTHUR D. FISK Oct. 1992 152 p
(Contract F33615-88-C-0015)
(AD-A258473; AL-TR-1992-0134) Avail: CASI HC A08/MF A02

A three-year research effort which investigated automatic processing theory and high performance skills training is sumarized. Issues pertaining to skill acquisition, transfer of training, skill retention, and operator workload were investigated with a variety of search and decision making tasks which were intended to represent laboratory analogs of some Command and Control (C2) operator functions. The results indicate that automatic processing can be developed with training in C2 task analogs, and suggest some conditions and limits on both the acquisition and transfer of automatic processing under conditions that are expected to be encountered within C2 systems. The results also indicate that there is minimal loss of automatic processing over retention intervals of up to one year, and demonstrate that the workload associated with task performance is reduced under automatic processing conditions. Performance principles and training guidelines that are based on the results of this effort are presented. GRA

N93-18291# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE UNIQUE CONTRIBUTION OF SELECTED PERSONALITY TESTS TO THE PREDICTION OF SUCCESS IN NAVAL PILOT TRAINING
D. R. STREET, JR., K. T. HELTON, and D. L. DOLGIN Aug. 1992 15 p
(AD-A258144; NAMRL-1374) Avail: CASI HC A03/MF A01

This study concerns the relationship of naval flight training performance to scores on the Aviation Qualification Test/Flight Aptitude Rating (AQT/FAR) and the automated Pilot Personality Questionnaire (PPQ). We analyzed a sample of 211 pilot candidates who had taken the AQT/FAR and PPQ. We found that the PPQ competitiveness scale and three of the AQT/FAR subtest score means were significantly different (p less than .05) for those who passed (N = 168) and those who attrited (N = 43) flight training. Discriminant analysis yielded a linear composite of the AQT/FAR and PPQ subtest variables that could be used to classify the students according to the likelihood of passing or attriting during flight training. The resulting discriminant function explained 9 percent of the variance in the pass/attrite criterion (r = .30). We found that a 50 percent reduction in attritions could be attained with a 23 percent increase in false rejections. The regression analysis was significant (p less than .01) and indicated that three scales of the PPQ and the AQT and FAR scores accounted for unique variance in a linear prediction equation. The FAR and PPQ competitiveness scale were the most powerful predictors of overall flight training success. GRA

N93-18294# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE EFFECT OF COMBAT ON AIRCREW SUBJECTIVE READINESS AND LSO GRADES DURING OPERATION DESERT SHIELD/STORM Final Report
SCOTT A. SHAPPELL and DAVID F. NERI May 1992 40 p
(Contract NR PROJ. MM3-3-P-30)
(AD-A258156; NAMRL-1369) Avail: CASI HC A03/MF A01

The effect of operational tasking on aircrew readiness during combat operations continues to be an area of intense investigation within the U.S. Navy. The recent Persian Gulf War provided a unique opportunity to collect data examining aircrew work/rest cycles and operational tasking in a combat environment. For 4 consecutive weeks during Operations Desert Shield and Desert Storm, 18 A-6 and 18 F-14 aviators onboard the USS AMERICA (CV-66) completed daily work/rest logs of their activities while conducting operations from the Red Sea. Activities on the work/rest logs were coded to a resolution of one-half hour. Several flight parameters were also obtained: (1) takeoff and landing time, (2) flight duration, (3) mission type, (4) consecutive days during which a flight occurred, (5) landing signal officer (LSO) scores, and (6) arresting wire engaged on landing. In addition, after each mission, aircrew provided a subjective assessment of the amount of time that they needed to rest before another air-to-ground strike mission could be flown (a measure of subjective readiness). Multiple regression analysis indicates that flight duration, the number of flights per day, and the time-of-day that the flight occurred, impact heavily on subjective evaluations of aircrew readiness. Few consistent relationships were observed between the independent measures and LSO grades. The data obtained here represent a unique look at aircrew work/rest patterns as they effect aircrew readiness during armed conflict. GRA

N93-18298# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A STUDY OF ILLNESS RELATED LOST TIME IN TRANSPORT AIRCRAFT CREWMEMBERS M.S. Thesis
DAVID J. LOUIS May 1992 62 p
(AD-A258193; AFIT/CI/CIA-92-89) Avail: CASI HC A04/MF A01

The purpose of this study was to determine if the illness rates of nonpilot air crewmembers are different from pilots. Interest in aircrew illness rates began when schedulers and flight surgeons noticed that frequently there were insufficient numbers of healthy flight engineers to staff the mission. When the literature on aircrew illness rates was reviewed, few studies were found. This study involved the compilation of illness data including the following: diagnosis job title (pilot (P), flight engineer (FE), loadmaster (L)); date of illness onset; and date of recovery for a military airlift wing in the southeastern United States over a two year period. Total time lost rates were calculated for each crew position for all illness and the seven most frequent diagnostic categories. Pilots were used as the comparison (referent) group. The database identified 1976 illnesses (events) in 569,969 person-days at risk. Time lost rates (days lost per 1000 person-days at risk) were significantly higher for flight engineers (56.2, p less than .001) and loadmasters (64.0, p less than .001) when compared to pilots (29.8). Incidence rates (new illness events per 1000 person-days at risk) were significantly higher for flight engineers (3.87, p less than .001) and loadmasters (4.07, p less than .001) than for pilots (2.76). Mean duration of illness was also longer for flight engineers at 8.4 days, and loadmasters at 9 days, than pilots at 6.6 days. GRA

N93-18359*# Columbia Univ., New York, NY.
DECISION PATHS IN COMPLEX TASKS Final Technical Report
EUGENE GALANTER 1991 9 p
(Contract NAGW-860)
(NASA-CR-192121; NAS 1.26:192121) Avail: CASI HC A02/MF A01

Complex real world action and its prediction and control has escaped analysis by the classical methods of psychological research. The reason is that psychologists have no procedures to parse complex tasks into their constituents. Where such a division can be made, based say on expert judgment, there is no natural scale to measure the positive or negative values of the components. Even if we could assign numbers to task parts, we lack rules i.e., a theory, to combine them into a total task representation. We compare here two plausible theories for the amalgamation of the value of task components. Both of these theories require a numerical representation of motivation, for motivation is the primary variable that guides choice and action in well-learned tasks. We address this problem of motivational quantification and performance prediction by developing psychophysical scales of the desireability or aversiveness of task components based on utility scaling methods (Galanter 1990). We modify methods used originally to scale sensory magnitudes (Stevens and Galanter 1957), and that have been applied recently to the measure of task 'workload' by Gopher and Braune (1984). Our modification uses utility comparison scaling techniques which avoid the unnecessary assumptions made by Gopher and Braune. Formula for the utility of complex tasks based on the theoretical models are used to predict decision and choice of alternate paths to the same goal. Author

N93-18868# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

HUMAN PERFORMANCE ASSESSMENT METHODS [METHODES D'EVALUATION DE LA PERFORMANCE MENTALE]

ERIC FARMER, ed. 1991 10 p

(AGARD-AG-308-ADD; ISBN-92-835-0600-6) Avail: CASI HC A02/MF A01

The purpose of this Addendum to AGARD-AG-308 is to provide changes and enhancements learned from AGARD Lecture Series 163. The Lecture Series occurred in June 1989 and was used to introduce the tests defined in AGARD-AG-308 to the international scientific community. The intent of Working Group 12, to make the AGARD STRES Battery an international standardized test battery, was supported by the success of Lecture Series 163. This Addendum provides additional information regarding the technical aspects of the STRES Battery and adds a section to Chapter 3 on Data Exchange Management. The information provided on Data Exchange Management will allow effective exchange on data and provide a mechanism for the process of evolution of the tests and refinement of their psychometric properties. Author

N93-18949# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

THE EFFECTS OF ICONIC PRESENTATION ON INDIVIDUALS M.S. Thesis

ELLEN T. BARBER and ELIZABETH C. DUNN Sep. 1992 142 p

(AD-A258785; AFIT/GCA/LSY/92S-1) Avail: CASI HC A07/MF A02

This thesis investigated whether individuals interpreted iconic graphs differently than traditional graphs. A literature review revealed a lack of current research concerning iconic graphs. Using guidelines previously created for high-integrity graphics, a timed, pretest-posttest experiment was developed to compare the impressions rendered by both traditional and iconic graphs to determine whether men and women interpret the two types of graphs in the same way. It was also used to determine whether traditional bar graphs or iconic graphs were preferred by the subjects. Ninety-nine subjects, all employees of the Royal Australian Air Force/United States Air Force, or defense contractors, were involved in the experiment. Through the use of the Mann-Whitney U Test, it was determined that the method of presentation did not affect an individual's interpretation of the graph. Individuals did, however, prefer the traditional methods of presentation. It was also determined that gender did not have an affect on an individual's ability to interpret a graph. GRA

N93-19449# Naval Undersea Warfare Center, New London, CT.

STIMULUS PRESENTATION FORMATS AND MEASUREMENT TECHNIQUES FOR THE QUANTIFICATION OF TARGET DETECTION PERFORMANCE Final Report

W. R. SALAFIA and D. A. DAROS 6 Oct. 1992 29 p

(AD-A258933; NUWC-NL-TR-10193) Avail: CASI HC A03/MF A01

The forced-choice (FC) format for stimulus presentation and performance assessment has been gaining popularity over other formats in a variety of human performance tasks, such as target detection and acquisition. Laboratory experiments, comparison investigations, and system performance assessments that require statistical testing, for example sonar system MDL, have been reported in the literature with claims that use of the FC procedure leads-to simplification of data handling and increased cost-effectiveness. These and other claims are examined in the present report and a number of concerns are raised about the nature of the information acquired when the FC method is used for the quantification of performance in tasks that primarily involve vigilance, monitoring, and search behaviors. These concerns may be summarized as follows. First, the kinds of performance outcomes assessed using the FC format are often different from those assessed by continuous-search (CS) procedures. Second, the FC format holds some aspects of response bias constant, making it impossible to assess many variables that are of paramount importance in sonar system development, such as the effects on performance of signal probability, motivation, training, and experience. Third, the procedures have sometimes been misunderstood, and the term forced-choice has been misapplied to situations that technically are not FC. Finally, although there may be some valid practical reasons for using the FC format for stimulus presentation in final system performance evaluation, there is no compelling evidence that the method is superior to others in terms of data analysis, programming, or cost efficiency for the controlled laboratory experiment. GRA

N93-19660# Gulhane Skeri Tip Akademisi, Eskisehir (Turkey). Aerospace Medical Center.

ASSESSMENT OF MORALE IN TURKISH AIR FORCE PILOTS WITH TWO CLINICAL PSYCHOLOGICAL TESTS

MUZAFFER CETINGUC, SAIT DEGER, and O. YALUG *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 4 p Sep. 1992

Copyright Avail: CASI HC A01/MF A04

In popular understanding good morale is equal to the perception of well being, lack of distress and absence of anxiety and depression. Actually the term morale is related to anxiety and depression. The rational of this survey is to assess numerically stress levels by using anxiety and depression scores. 345 active duty Turkish Air Force (TuAF) pilots and 70 non-flying air force officers as control group, have been taken into this study. 'State Trait Personality Inventory' (STPI-Spielberger) and 'Zung Depression Scale' (ZDS) were applied to both groups in 1988. As an unexpected result, the flyer group has reflected lower scores than the non-flyers. Different explanations are available but they are most likely to be related to high motivation and job satisfaction as well as ego strengths of flyers. These factors can elevate the ability to cope with stressful conditions. Author

N93-19679# Air Force Human Resources Lab., Brooks AFB, TX.

EPIDEMIOLOGY OF UNITED STATES AIR FORCE SPATIAL DISORIENTATION ACCIDENTS: 1990-1991

TERENCE J. LYONS, WILLIAM R. ERCOLINE, JAMES E. FREEMAN, and KENT K. GILLINGHAM *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 11 p Sep. 1992

Copyright Avail: CASI HC A03/MF A04

Spatial disorientation (SD) continues to be a contributing factor to a fairly constant proportion of military aircraft accidents. The United States Air Force (USAF) fielded a new accident investigation reporting form in July 1989, which for the first time specified SD Type 1, Type 2, and Type 3 as possible causes of aircraft accidents. Of a total of 91 major accidents that occurred over the 2-year period beginning in October 1989, SD contributed significantly to 13 (14 percent). Although this percentage is higher than that reported in previous studies, the actual rate of SD accidents per 100,000 flying hours (.1843) is lower than previously reported. Type 1 SD was the cause of all 13 accidents; 9 of the 13 were fatal; 6 occurred in night or instrument meteorological conditions (IMC) conditions; and 11 involved cockpit attention problems, such as inattention, distraction, or channelized attention. Pilot inexperience did not appear to be a factor: average total flying time for the 13 pilots was 1,687 hours. Coding for SD on accident investigation reporting forms was not consistent. There were both individual differences between flight surgeons and pilots, and trends in reporting overtime. There is, however, a consensus that SD represents a major problem in military aviation. A scientific approach to this important problem would be facilitated if agreement could be reached on definitional and semantic issues. Author

N93-19680# Army Air Corps, Stockbridge (England).

DISORIENTATION AND FLIGHT SAFETY: A SURVEY OF UK ARMY AIRCREW

S. J. DURNFORD *In* AGARD, Aircraft Accidents: Trends in

Aerospace Medical Investigation Techniques 14 p Sep. 1992
Copyright Avail: CASI HC A03/MF A04

This paper reports the finding of a questionnaire survey intended to gather disorientation. 440 UK Army aircrew were targeted and the response rate was 79 percent. The survey confirmed the high incidence of disorientation (24 percent of aircrew had suffered at least one episode severe enough to have put flight safety at risk at some point during their flying career and 6 percent had suffered such an episode in the previous 4 months). Only 10 percent had never suffered any disorientation. I.I.C.

N93-19681# Sextant Avionique, Saint Medard en Jalles (France).

OTOLITHIC ILLUSIONS ON TAKEOFF AND VISUAL INFORMATION: REFLECTIONS IN CONNECTION WITH AN AIR ACCIDENT CASE [ILLUSIONS OTOLITHIQUES AU DECOLLAGE ET INFORMATIONS VISUELLES: REFLEXIONS A PROPOS D'UN CAS D'ACCIDENT AERIEN]

A. LEGER, C. MARTIN, and R. PARUS *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992 In FRENCH
Copyright Avail: CASI HC A02/MF A04

Otolithic illusions on takeoff (takeoff illusions) have long been known as causes of air accidents. They originate in acceleration + Jx of the aircraft which, while adjusting to the gravity vector, produces an otolithic stimulation generating an excessive feeling of being pulled (somatogravic illusion). This type of illusion appears primarily when the visual references are insufficient (night takeoff, foggy environment). An air accident having led to the loss of a modern combat aircraft is reported. The circumstances and the various parameters of flight (accelerations Jx and Jz, speed, trajectory and altitude, actions of the pilot, etc.) are analyzed. From these data, the resulting otolithic stimulation undergone by the pilot during the flight was reconstituted. The evolution of this stimulation makes it possible to explain perfectly the actions carried out by the pilot, making this accident a typical example of takeoff illusion. The analysis of this air accident shows that the pilot never seemed to have used the visual attitude information presented by the head high visor in the aircraft. Beginning with these elements, a reflection of the visual information of the space orientation presented in the sights is carried out. It results in the consideration of various solutions likely to reduce the risks of confusion. The introduction of display systems connected to the head poses a certain number of new problems in this field, but also opens up interesting prospects. Author

N93-19682# Centre d'Enseignement et de Recherches des Industries Alimentaires et Chimiques, Brussels (Belgium).

COGNITIVE FACTORS IN THE AIR EVENTS OF THE AIR FORCE DURING THE LAST DECADE [LES FACTEURS COGNITIFS DANS LES EVENEMENTS AERIENS DE L'ARMEE DE L'AIR AU COURS DE LA DERNIERE DECENNIE]

J. Y. GRAU, R. AMALBERTI, and J. P. MENU *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 6 p Sep. 1992 In FRENCH
Copyright Avail: CASI HC A02/MF A04

Accident prevention has been a continuous concern since the early beginnings of aviation. Early efforts in prevention have been devoted to system reliability, then to physiological factors. Improvements in both these directions lead to consider cognitive factors as the main source of accidents. Prevention effort must take into account pilots' cognitive processes. In depth cognitive analysis of aircraft accidents serve to point out error mechanisms. Statistics complete this figure showing the respective occurrence frequency of these mechanisms, therefore orient the preventive actions. Such an approach, focused on the cognitive factors involves to define a specific analysis grid from psychological theories on human error. The elaborated grid is the basis to design a cognitive oriented data base. Author

N93-19703# Naval Aerospace Medical Research Lab., Pensacola, FL. Naval Aerospace Medical Inst.

MEDICAL EVALUATION OF SPATIAL DISORIENTATION MISHAPS

A. RUPERT, F. E. GUEDRY, and J. CLARK *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 5 p Sep. 1992
Copyright Avail: CASI HC A01/MF A04

Spatial Disorientation (SD) is a leading human-factors cause of class A mishaps in all branches of the U.S. Armed Forces. Recently, several pilots who performed well under most flight conditions were referred to the Naval Aerospace Medical Research Laboratory (NAMRL) because of inability to fly under specific conditions conducive to SD. Most had been neurologically classified as normal using the presently available clinical tests. The pilots were then referred to NAMRL for assessment of vestibular function. Some of these pilots demonstrated perceptual anomalies in attitude perception that rendered them unable to fly safely under select combinations of acceleration and visual presentations. Although U.S. Navy pilot applicants are thoroughly assessed to meet visual and auditory standards, there are no specific screening tests for vestibular function. Thus, it is possible for members of the pilot community to possess reactions that under certain conditions will render them particularly susceptible to SD. In response to requests from clinicians, we have initiated the development of a Pensacola Vestibular Test Battery (PVTB) to assess aircrew referrals. The PVTB is being used to build a normative and pathological data base that will be incorporated into mathematical models that will inform the clinicians of the perceptual consequences of vestibular anomalies in the flight environment. The same computer-based models will be useful for aircraft design, pilot selection, and mishap investigation. Author

N93-19705# Hopital Ambroise Pare, Boulogne-Billancourt (France).

THE INFLUENCE OF INDIVIDUAL SENSIVITY TO STRESS ON THE BEHAVIOR (ATTITUDE AND PERFORMANCE) OF AVOIDANCE OF AN ACCIDENT [INFLUENCE DE LA SENSIBILITE INDIVIDUELLE AU STRESS SUR LE COMPORTEMENT (ATTITUDE ET PERFORMANCE) D'EVITEMENT D'ACCIDENT]

CLAIRE PETIT, ALAIN PRIEZ (Hopital Raymond Poincare, Garches, France), CLAUDE TARRIERE (Centre National de la Recherche Scientifique, Lyon, France), ANDRE DITTMAR (Centre National de la Recherche Scientifique, Lyon, France), and EVELYNE VERNET-MAURY *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 7 p Sep. 1992 In FRENCH
Copyright Avail: CASI HC A02/MF A04

The Department of Environmental Sciences of RENAULT studies the behavior of a broad sample of drivers (100 people of both sexes, of all ages and all driving experiences) implied in an accidental situation (simulation of an intersection between two roads). The goal is to analyze the way in which the driver of a car uses the device for anti-locking wheels or not, not only to slow down but also to carry out a lateral offset in order to avoid the obstacle. It appears that the sensitivity of the subjects to stress, evaluated by a physiological approach during the experiments but also by psychological tests carried out before and after the experiments, explains for a considerable portion the success or failure to avoid the obstacle. Author

N93-19709# Gulhane Skeri Tip Akademisi, Eskisehir (Turkey).

GREMLINS: A DOZEN HAZARDOUS THOUGHT AND BEHAVIOR PATTERNS AS RISK FACTORS

MUZAFFER CETINGUC *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 4 p Sep. 1992
Copyright Avail: CASI HC A01/MF A04

The term 'Gremlins' is known as fictitious ill-tempered spirits loved by children as comic strips and movie characters. During World War 2, it was an easy and unscientific way to throw blame on Gremlins which were considered responsible for unexplainable mechanical difficulties, as if a gin caused malfunctions in the

aircraft. It was the gremlin, that diagnosis of pilots and engineers for mechanical malfunctions, that caused aircraft accidents during World War 2. Today they are nothing but puppets and movie characters. Reasons of accidents are explained by more scientific methods. Although modern technology presents materials providing safety in almost all conditions, accidents continue on faults rising from human beings. In this concept, it fits more to use gremlins as 'ill-temperness belonging human psychology that may cause risk'. Some certain personality variances effect the decision and judgement functions. These disorders reflected to thinking and behavior, sometimes may be leading reasons of accidents. I.I.C.

N93-19956# Search Technology, Inc., Norcross, GA.
MODELING THE DYNAMICS OF MENTAL WORKLOAD AND HUMAN PERFORMANCE IN COMPLEX SYSTEMS Final Report, 1 Sep. 1991 - 10 Aug. 1992
WILLIAM B. ROUSE, SHARON L. EDWARDS, and JOHN M. HAMMER Aug. 1992 31 p
(Contract F33615-88-C-3612)
(AD-A258553; WL-TR-92-3095) Avail: CASI HC A03/MF A01

This program studied the relationship between subjective workload and human behavior and proposed a model of the dynamics of this relationship. Results of three simulation experiments are detailed in this report and show that simple linear identification algorithms are robust in online identification of noisy, nonlinear versions of the model. This model and the associated algorithms have the potential to enable online inferences of workload and could be used to prompt/invoke human aiding or automated systems to help reduce workload. Applications for such systems exist in aiding aircraft pilots; command, control, communication decision makers; and other personnel in dynamic, time constrained environments. GRA

N93-20326# Medical Research Council, London (England).
THE CENTRAL EXECUTIVE COMPONENT OF WORKING MEMORY Annual Report, 1 Sep. 1991 - 31 Aug. 1992
A. BADDELEY, J. DUNCAN, and H. EMSLIE 31 Oct. 1992 21 p
(Contract AF-AFOSR-0343-90)
(AD-A258724; AFOSR-92-0946TR) Avail: CASI HC A03/MF A01

Our approach to the central executive (CE) involves combined studies of dual task interference, frontal lobe function and general intelligence or Spearman's g. In this reporting period we have focused on dual task interference, in particular using variants of Baddeley's (1986) random generation task, thought to load the CE because of its continual requirement for novel, non- stereotyped responding. Results suggest three main conclusions. First, the CE is modality-independent, in contrast to the peripheral slave systems of working memory. Second, there is a link between CE requirements and frontal lobe functions, indicated by substantial interference between random generation and a conventional frontal task, word fluency. Third, there is some tendency for tasks with high g correlations also to show the greatest interference with random generation. Taken together, these results support the convergence of methods from experimental cognitive psychology, neuropsychology and differential psychology, to define a common CE system. GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A93-21906
MOISTENING OF THE SUBSTRATE IN MICROGRAVITY
TANIA IVANOVA (Bulgarian Academy of Sciences, Space Research Inst., Sofia, Bulgaria) and I. DANDOLOV Microgravity Science and Technology (ISSN 0938-0108) vol. 5, no. 3 Dec. 1992 p. 151-155. refs
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A preliminary experiment to study the hydrodynamical properties of the Balkanine substrate, a nutrient medium used for plant cultivation in the SVET greenhouse, was carried out in 1985 on board Salyut-7 orbital station. The spatial distribution of water in four cassettes filled with different substrate fraction was observed for more than 24 hr. The obtained results are compared to a parallel ground-based synchronous experiment. A method for measuring substrate moisture is tested. In 1990, vegetables were grown in the SVET greenhouse on board the Mir space station. Two sensors were used to observe variations in their values during a 54-d experiment. C.A.B.

A93-22827
SPACE BASED ROBOT MANIPULATORS - DYNAMICS OF CONTACT AND TRAJECTORY PLANNING FOR IMPACT MINIMIZATION
LIANG-BOON WEE and MICHAEL W. WALKER (Michigan Univ., Ann Arbor) *In* 1992 American Control Conference, 11th, Chicago, IL, June 24-26, 1992, Proceedings. Vol. 1 Piscataway, NJ Institute of Electrical and Electronics Engineers 1992 p. 771-775. refs
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The authors consider contact between free-flying space robots, and the minimization of the impulse at impact. They begin with a presentation of a model of space robot which takes into account external applied forces. A contact model which considers both linear and angular motion between contacting systems is presented. Two approaches for trajectory planning in Cartesian space are discussed, and a strategy for achieving both the primary objective of trajectory tracking in Cartesian space and the secondary objective of impact minimization through configuration space planning is presented. The strategy was tested on a 15 degree-of-freedom space robot, and simulation results are presented. I.E.

A93-22916
KALMAN-FILTER-BASED MACHINE VISION FOR CONTROLLING FREE-FLYING UNMANNED REMOTE VEHICLES
HAROLD L. ALEXANDER, ALI J. AZARBAYEJANI, and HARALD J. WEIGL (MIT, Cambridge, MA) *In* 1992 American Control Conference, 11th, Chicago, IL, June 24-26, 1992, Proceedings. Vol. 3 Piscataway, NJ Institute of Electrical and Electronics Engineers 1992 p. 2006-2010. refs
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A Kalman-filter-based system for machine vision has been developed that is computationally efficient and provides high-quality position and attitude data when used to track the motion of a mobile vehicle carrying a vision camera. The system achieves the required speed for real-time control through use of simple geometric models of the perceived target, dependence on tracking rather than object recognition, and reduction of the scene analysis task from a two-dimensional process to a set of one-dimensional scans through the image. The system is intended for application to a neutrally buoyant vehicle called STAR that simulates a freely flying, extravehicular space robot. The vision system will support development of autonomous and teleoperator control technologies for space robots, and the experimental results presented here result from preliminary target-pointing experiments with the STAR vehicle. I.E.

A93-23518* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUAL DISPLAY AID FOR ORBITAL MANEUVERING - DESIGN CONSIDERATIONS
ARTHUR J. GRUNWALD (Technion - Israel Inst. of Technology, Haifa) and STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090) vol. 16, no. 1 Jan.-Feb. 1993 p. 139-144. refs
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This paper describes the development of an interactive proximity operations planning system that allows on-site planning of fuel-efficient multiburn maneuvers in a potential multispacecraft environment. Although this display system most directly assists planning by providing visual feedback to aid visualization of the trajectories and constraints, its most significant features include: (1) the use of an 'inverse dynamics' algorithm that removes control nonlinearities facing the operator, and (2) a trajectory planning technique that separates, through a 'geometric spreadsheet', the normally coupled complex problems of planning orbital maneuvers and allows solution by an iterative sequence of simple independent actions. The visual feedback of trajectory shapes and operational constraints, provided by user-transparent and continuously active background computations, allows the operator to make fast, iterative design changes that rapidly converge to fuel-efficient solutions. The planning tool provides an example of operator-assisted optimization of nonlinear cost functions. Author

A93-23519* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUAL DISPLAY AID FOR ORBITAL MANEUVERING - EXPERIMENTAL EVALUATION
ARTHUR J. GRUNWALD (Technion - Israel Inst. of Technology, Haifa) and STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090) vol. 16, no. 1 Jan.-Feb. 1993 p. 145-150. refs
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An interactive proximity operations planning system, which allows on-site planning of fuel-efficient, multiburn maneuvers in a potential multispacecraft environment, has been experimentally evaluated. An experiment has been carried out in which nonastronaut operators with brief initial training were required to plan a trajectory to retrieve an object accidentally separated from a dual-keel Space Station, for a variety of different orbital situations. The experiments have shown that these operators were able to plan workable trajectories, satisfying a number of operational constraints. Fuel use and planning time were strongly correlated, both with the angle at which the object was separated and with the existence of spatial constraints. Planning behavior was found to be strongly operator-dependent. This finding calls for the need for standardizing planning strategies through operator training or the use of semiautomated planning schemes. Author

A93-23846* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COLLISION AVOIDANCE OF A MULTIPLE DEGREE OF REDUNDANCY MANIPULATOR OPERATING THROUGH A WINDOW
H. ZGHAL (Manitoba Univ., Winnipeg, Canada), R. V. DUBEY, and J. A. EULER (Tennessee Univ., Knoxville) ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control (ISSN 0022-0434) vol. 114, no. 4 Dec. 1992 p. 717-721. refs
(Contract NAG1-1008; NSF MSS-89-10095)
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The problem of collision-free operation of a multiple-degree-of-redundancy manipulator operating through a window is addressed. An efficient gradient projection optimization scheme is presented for the kinematic control of manipulators with multiple degrees of redundancy. This scheme was developed for dextrous robotic and telerobotic applications in space station construction as well as in congested shop floor environment. A performance criterion is defined to maximize the shortest distances between the manipulator links and the edges of the window. Effectiveness of this scheme and the validity of the performance criterion are verified through simulations of the seven-degree-of-freedom NASA Laboratory Telerobotic Manipulator. Author

A93-24046
FLIGHT HELMET WEIGHT, +GZ FORCES, AND NECK MUSCLE STRAIN
OLAVI HAMALAINEN (Air Force Academy, Kauhava, Finland) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 55-57. Research supported by Finnish Defence Forces refs
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The aim of this study was to investigate the effect of flight helmet weight on cervical erector spinae muscle strain under high +Gz forces. Two helmets of different weight were compared by recording inflight neck muscle activities with a portable surface-integrated EMG (IEMG) device. The obtained IEMG activities were normalized by comparing them with activities representing maximal voluntary contraction (MVC) of the muscles. Two test pilots carried out a total of 16 flights consisting of a series of different maneuvers. The results indicate that a lighter flight helmet may - at least in some pilots - cause less strain on neck structures than a heavier one. The effect of helmet weight was readily apparent only under high +Gz forces; changing from a heavier to a lighter helmet reduced the mean muscular strain from 9.5 to 8.8 percent and from 20.2 to 17.1 percent of the MVC under + 4.0 and + 7.0 Gz, respectively. Thus, some, but not all, acute inflight neck pain and related problems might be avoided by using lighter flight helmets. Author

A93-24050
INDIVIDUAL DIFFERENCES AND SUBGROUPS WITHIN POPULATIONS - THE SHOPPING BAG APPROACH
STEPHEN E. POPPER and KATHY MCCLOSKEY (USAF, Armstrong Lab., Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 1 Jan. 1993 p. 74-77. refs
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A 'shopping bag' approach to the problem of subordination of the individual to the population mean/standard deviation is discussed. In this approach each individual may select those performance enhancers that work best for him or her. Acceleration protection devices are used as an example. This philosophy affects human factor design strategy and the interpretation of human research data. O.G.

A93-24490#
SIMULATOR SICKNESS EXPERIENCE IN SIMULATORS EQUIPPED WITH FIBER OPTIC HELMET MOUNTED DISPLAY SYSTEMS
R. V. KRUK (CAE Electronics, Ltd., Montreal, Canada) Aug. 1992 16 p. AIAA and AHS, Flight Simulation Technologies Conference, Hilton Head Island, SC, Aug. 24-26, 1992 refs
(AIAA PAPER 92-4135) Copyright

Simulator sickness studies have indicated that deliberate degradation of such selected system parameters of a fiber-optic head-mounted display (FOHMD) as visual-scene update rate and heat-tracker update rate can provoke simulator sickness symptoms. When the system was operating within normal specifications, however, simulator sickness incidence was low relative to other wide-field-of-view fighter simulators. To determine whether vehicle handling characteristics' predictability affects the tendency of a simulation to induce simulator sickness, low level/low speed maneuvers were flown by a simulator complexity testbed whose FOHMD is similar to the system installed in the initial simulator. The results thus obtained are discussed. O.C.

A93-24873#
RESEARCH AND DEVELOPMENT OF SENSING AND MANIPULATION TECHNIQUES FOR SPACE ROBOTICS ON A TESTBED
N. MUROI, N. KUBOTA, K. OGIMOTO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), M. HIRAYAMA, S. UEADA, K. IOI, and O. NORO (Kawasaki Heavy Industries, Ltd., Akashi, Japan) Jan. 1993 8 p. AIAA, Aerospace Sciences Meeting and Exhibit, 31st, Reno, NV, Jan. 11-14, 1993 Research supported by

NASDA refs
(AIAA PAPER 93-0794) Copyright

The continuing research and development work in remote operation of space robotics is presented. Principal technologies, including sensing and manipulation to perform an orbital replacement unit exchange and a fuel resupply, have been studied on a testbed. These essential techniques are to be integrated to establish a teleoperation system for a future space robot. R.E.P.

A93-24923#
INCORPORATING DISPLAY LIMITATIONS IN A MODEL-BASED ANALYSIS OF FLIGHT SIMULATOR FIDELITY
R. A. HESS (California Univ., Davis) Jan. 1993 13 p. AIAA, Aerospace Sciences Meeting and Exhibit, 31st, Reno, NV, Jan. 11-14, 1993 refs
(AIAA PAPER 93-0859) Copyright

A model-based technique for incorporating display limitations in the analysis of flight simulator fidelity is introduced. The technique builds upon a methodology proposed for the preliminary assessment of flight simulator fidelity which uses a structural model of the human pilot. It is hypothesized that the effect of degradations in display quality upon human pilot dynamics can be modeled by a simple gain reduction in a proprioceptive feedback loop in the structural pilot model. This model is incorporated in what is termed the primary control loop(s) for the task at hand. A control theoretic rationale for this gain reduction is presented. The implications of display limitations upon perceived handling qualities is discussed. Author

A93-24994* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FUSING HUMAN AND MACHINE SKILLS FOR REMOTE ROBOTIC OPERATIONS
PAUL S. SCHENKER, WON S. KIM, STEVEN C. VENEMA, and ANTAL K. BEJCZY (JPL, Pasadena, CA) *In* Sensor fusion III: 3-D perception and recognition; Proceedings of the Meeting, Boston, MA, Nov. 5-8, 1990 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1991 p. 202-223. refs
Copyright

The question of how computer assists can improve teleoperator trajectory tracking during both free and force-constrained motions is addressed. Computer graphics techniques which enable the human operator to both visualize and predict detailed 3D trajectories in real-time are reported. Man-machine interactive control procedures for better management of manipulator contact forces and positioning are also described. It is found that collectively, these novel advanced teleoperations techniques both enhance system performance and significantly reduce control problems long associated with teleoperations under time delay. Ongoing robotic simulations of the 1984 space shuttle Solar Maximum EVA Repair Mission are briefly described. P.D.

A93-25123
AN ANALYTICAL MODEL OF THE AIRCREW OXYGEN BREATHING SYSTEM
JENNIFER C. BYRNE (Conrad Technologies, Inc., Malvern, PA) and CAROL J. MCILWAIN-AXTEN (U.S. Navy, Naval Air Warfare Center, Warminster, PA) SAFE Journal vol. 22, no. 6 Nov.-Dec. 1992 p. 8-14. refs
Copyright

The Advanced Aircrew Oxygen Delivery System (AAODS) is an advanced development effort to determine the design requirements for a state-of-the-art aircrew breathing gas delivery system. The goal of this program is to develop a mathematical model of the oxygen system from aircrewman-to-aircraft and to define system parameters through an investigation of the aircrew requirements. Phase I of this program dealt with the development of an analytical model for the aircrew portion of the entire oxygen system. Phase II of the program involves the modeling of the aircraft oxygen systems. This paper discusses the development of the analytical model for the aircrew oxygen breathing system, performed under Phase I of the AAODS program. Component models of the man, mask, hose, and regulator have been developed and integrated within a computer program which features modularity, flexibility, and user friendly I/O. The results of the computer simulation enable the evaluation of the dynamic interaction of the aircrew oxygen breathing system components. Author

A93-25308* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM (CELSS) MODELING
ALAN DRYSDALE, MARK THOMAS, MARK FRESA (McDonnell Douglas Space Systems Co., Cocoa Beach, FL), and RAY WHEELER (NASA, Kennedy Space Center, Cocoa Beach, FL) *In* Space Congress, 29th, Cocoa Beach, FL, Apr. 21-24, 1992, Proceedings Cape Canaveral, FL Canaveral Council of Technical Societies 1992 p. 8-31 to 8-37.
Copyright

Attention is given to CELSS, a critical technology for the Space Exploration Initiative. OCAM (object-oriented CELSS analysis and modeling) models carbon, hydrogen, and oxygen recycling. Multiple crops and plant types can be simulated. Resource recovery options from inedible biomass include leaching, enzyme treatment, aerobic digestion, and mushroom and fish growth. The benefit of using many small crops overlapping in time, instead of a single large crop, is demonstrated. Unanticipated results include startup transients which reduce the benefit of multiple small crops. The relative contributions of mass, energy, and manpower to system cost are analyzed in order to determine appropriate research directions. P.D.

A93-25309
LIFE SUPPORT RESEARCH AND DEVELOPMENT FOR THE DEPARTMENT OF ENERGY SPACE EXPLORATION INITIATIVE
CHARLES D. SCOTT (Oak Ridge National Lab., TN), LAMAR J. JOHNSON (Idaho National Engineering Lab., Idaho Falls), WILLIAM W. SCHERTZ (Argonne National Lab., IL), JAMES A. WISE (Pacific Northwest Lab., Richland, WA), and CHARLES E. WYMAN (National Renewable Energy Lab., Golden, CO) *In* Space Congress, 29th, Cocoa Beach, FL, Apr. 21-24, 1992, Proceedings Cape Canaveral, FL Canaveral Council of Technical Societies 1992 p. 8-38 to 8-43. Previously announced in STAR as N92-26494 refs
(Contract DE-AC05-84OR-21400; W-31-109-ENG-38; DE-AC02-83CH-10093; DE-AC07-76ID-01570)
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Long-term, manned space missions of the future will require an approach life support systems in which most of the waste materials must be processed and recycled and/or local resources are utilized. The requirement for a reliable life support system has been recognized as an important component of the Space Exploration Initiative, and the Department of Energy (DOE), in conjunction with the National Aeronautical and Space Agency, is organizing a program in support of the development of this type of technology. It is quite likely that bioprocesses will be important components of the integrated system, and this will be the primary area of R&D within the DOE national laboratories. Initial research will include investigation of microbial, enzymatic, and thermochemical processing of wastes. Other reseach areas of interest include water and air purification by plants, microbial detection systems, biophotochemical CO2 recycle, tissue cultures for food, single-cell protein, bioadsorbents for pollutant removal, and several others. The resulting innovative technology developed for space exploration could also be the basis for approaches for the processing and recycle of waste materials on Earth. Author

A93-25363
HUMAN VISION, VISUAL PROCESSING, AND DIGITAL DISPLAY II; PROCEEDINGS OF THE MEETING, SAN JOSE, CA, FEB. 27-MAR. 1, 1991
BERNICE E. ROGOWITZ, ED. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY), MICHAEL H. BRILL, ED. (Science

Applications International Corp., McLean, VA), and JAN P. ALLEBACH, ED. (Purdue Univ., West Lafayette, IN) Bellingham, WA Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1453) 1991 431 p.
(SPIE-1453; ISBN 0-8194-0552-3) Copyright

Attention is given to the quality of displayed information; perceptual processing of spatial and spatio-temporal images; model-based image coding, compression, and enhancement; biologically based machine vision; and machine and human color vision. Particular attention is given to image quality measurements with a neural brightness perception model, a new approach to palette selection for color images; subjective evaluation of scale-space image coding, detecting spatial and temporal dot patterns in noise, a network compensation for missing sensors, quantization of color image components in the DCT domain, model-based halftoning, a computational model of an integrated vision system, a vision-based artificial texture perception, mean-field stereo correspondence for natural images, photometric models in multispectral machine vision, and apparent contrast and surface color in complex scenes. (For individual items see A93-25364 to A93-25366) O.G.

A93-25482
USING TACTILE INFORMATION IN TELEROBOTICS
ROGER A. BROWSE and MARCIA L. MCDONALD (Queen's Univ., Kingston, Canada) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472) vol. 22, no. 5 Sept.-Oct. 1992 p. 1205-1210. Research supported by Manufacturing Research Corp. of Ontario and Inst. for Robotics and Intelligent Systems refs
(Contract NSERC-A-2427)
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An array force sensor mounted on the gripper of a robot can provide information about the contact taking place with the environment. Limited success has been attained in the use of such sensors in identifying and localizing objects. Another promising use is in the provision of tactile information for telerobotic operation. Experiments have been carried out that test a variety of tactile display methods examining human performance in judgements about robotic manipulation. The pattern of performance across the different display methods suggests that the use of the tactile data is dependent on the availability of an intersensory model of the environment. Author

A93-25487
THE SPACE STATION REMOTE MANIPULATOR SYSTEM
ROBERT DANIELL (Spar Aerospace, Ltd., Weston, Canada) SPAR Journal of Engineering and Technology vol. 1, no. 1 May 1992 p. 1-6.
Copyright

This paper describes the current design of the Space Station Remote Manipulator System (SSRMS) and new mechanical designs developed for this application. The SSRMS is a major component of the mobile servicing system used for assembly, maintenance, and servicing of Space Station Freedom. The design allows remotely controlled relocation to other operating points on the Station and provides the capability to maintain and repair the manipulator in orbit using robotics and/or astronauts. System components such as the collet latch, power and data grapple fixture, and their functions are described. SSRMS joints, joint motor modules, orbital replacement units and their interfaces are discussed. A.O.

N93-17970*# Texas Univ., Austin. Mechanical Engineering Design Projects Program.
DESIGN OF A VIBRATION ISOLATION SYSTEM FOR A CYCLE ERGOMETER TO BE USED ONBOARD THE SPACE SHUTTLE Final Report
LILLIAN PEARSON, STEVEN TAIT, and MAURICE TREVINO 1991 157 p
(Contract NASW-4435)
(NASA-CR-192021; NAS 1.26:192021) Avail: CASI HC A08/MF A02

Low frequency vibrations generated during exercise using the cycle ergometer onboard the Space Shuttle are disrupting sensitive microgravity experiments. The design team is asked by NASA/USRA to generate alternatives for the design of a vibration isolation system for the cycle ergometer. It is the design team's objective to present alternative designs and a problem solution for a vibration isolation system for an exercise cycle ergometer to be used onboard the Space Shuttle. In the development of alternative designs, the design team emphasizes passive systems as opposed to active control systems. This decision is made because the team feels that passive systems are less complex than active control systems, external energy sources are not required, and mass is reduced due to the lack of machinery such as servomotors or compressors typical of active control systems. Eleven alternative designs are developed by the design team. From these alternatives, three active control systems are included to compare the benefits of active and passive systems. Also included in the alternatives is an isolation system designed by an independent engineer that was acquired late in the project. The eight alternatives using passive isolation systems are narrowed down by selection criteria to four considered to be the most promising by the design team. A feasibility analysis is performed on these four passive isolation systems. Based on the feasibility analysis, a final design solution is chosen and further developed. From the development of the design, the design team has concluded that passive systems are not effective at isolating vibrations for the low frequencies considered for this project. Recommendations are made for guidelines of passive isolation design and application of such systems. Author

N93-17971*# Kansas State Univ., Manhattan. Dept. of Mechanical Engineering.
AUTOMATION OF CLOSED ENVIRONMENTS IN SPACE FOR HUMAN COMFORT AND SAFETY Report, 1991-1992
1 Jun. 1992 122 p
(Contract NASW-4435)
(NASA-CR-192045; NAS 1.26:192045) Avail: CASI HC A06/MF A02

This report culminates the work accomplished during a three year design project on the automation of an Environmental Control and Life Support System (ECLSS) suitable for space travel and colonization. The system would provide a comfortable living environment in space that is fully functional with limited human supervision. A completely automated ECLSS would increase astronaut productivity while contributing to their safety and comfort. The first section of this report, section 1.0, briefly explains the project, its goals, and the scheduling used by the team in meeting these goals. Section 2.0 presents an in-depth look at each of the component subsystems. Each subsection describes the mathematical modeling and computer simulation used to represent that portion of the system. The individual models have been integrated into a complete computer simulation of the CO2 removal process. In section 3.0, the two simulation control schemes are described. The classical control approach uses traditional methods to control the mechanical equipment. The expert control system uses fuzzy logic and artificial intelligence to control the system. By integrating the two control systems with the mathematical computer simulation, the effectiveness of the two schemes can be compared. The results are then used as proof of concept in considering new control schemes for the entire ECLSS. Section 4.0 covers the results and trends observed when the model was subjected to different test situations. These results provide insight into the operating procedures of the model and the different control schemes. The appendix, section 5.0, contains summaries of lectures presented during the past year, homework assignments, and the completed source code used for the computer simulation and control system. Author

N93-17973*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DESIGN OF A REUSABLE KINETIC ENERGY ABSORBER FOR AN ASTRONAUT SAFETY TETHER TO BE USED DURING EXTRAVEHICULAR ACTIVITIES ON THE SPACE STATION Final Report
DAWN E. BORTHWICK, DANIEL F. CRONCH, and GLEN R. NIXON 1991 158 p
(Contract NASW-4435)
(NASA-CR-192015; NAS 1.26:192015) Avail: CASI HC A08/MF A02

The goal of this project is to design a reusable safety device for a waist tether which will absorb the kinetic energy of an astronaut drifting away from the Space Station. The safety device must limit the tension of the tether line in order to prevent damage to the astronaut's space suit or to the structure of the spacecraft. The tether currently used on shuttle missions must be replaced after the safety feature has been developed. A reusable tether for the Space Station would eliminate the need for replacement tethers, conserving space and mass. This report presents background information, scope and limitations, methods of research and development, alternative designs, a final design solution and its evaluation, and recommendations for further work. Author

N93-18018*# Texas Univ., Austin. Dept. of Mechanical Engineering.
CONCEPTUAL DESIGN OF A FLEET OF AUTONOMOUS REGOLITH THROWING DEVICES FOR RADIATION SHIELDING OF LUNAR HABITATS Supplemental Report
KAREM ARMSTRONG, DANIEL A. MCADAMS, and JEFFERY L. NORRELL 1992 41 p Sponsored by NASA. Johnson Space Center
(NASA-CR-192030; NAS 1.26:192030) Avail: CASI HC A03/MF A01

This report presents refinements in two areas of the initial design presented in the report entitled 'Conceptual Design of a Fleet of Autonomous Regolith Throwing Devices for Radiation Shielding of Lunar Habitats'. The first section presents an evaluation of the critical areas of the design and presents alternative solutions for these areas. The areas for design refinement are the traction required by the device and the stability of the device when throwing regolith. Several alternative methods are presented to solve these problems. First, the issue of required traction is covered. Next, the design is refined to provide a more stable device. The issue of stability is addressed both by presenting solutions for the configuration chosen for the computer simulation and by presenting two more device configurations. The next section presents the selected solutions. To prevent inadequate traction, the depth of dig-per-pass is reduced. A method combining a dynamic counterweight and an outrigger is chosen to provide a stable device. Author

N93-18019*# Texas Univ., Austin.
PRELIMINARY DESIGN OF A RADIATOR SHADING DEVICE FOR A LUNAR OUTPOST
CARLOS BARRON, NORMA I. CASTRO, and BRIAN PHILLIPS 1991 143 p
(Contract NASW-4435)
(NASA-CR-192016; NAS 1.26:192016) Avail: CASI HC A07/MF A02

The National Aeronautics and Space Administration is designing a thermal control system for an outpost to be placed permanently on the Moon. One of the functions of the thermal control system is to reject waste heat, which can be accomplished through a radiator. At the lunar equator and during the lunar midday, an unshaded radiator absorbs more heat than it rejects. This problem can be solved by using a shading device to reduce radiation incident on the radiator. The design team was asked to develop concepts for reducing the radiation incident on the radiator and for deploying the radiator and shade system for a 10 kW and a 25 kW heat rejection system. The design team was also asked to develop the best concepts into preliminary design. From the several alternatives developed by the design team, the best one was selected using a decision matrix. Preliminary design of the best concept include support structure, stress analyses, and thermal performance. In addition, the team developed ideas for removing lunar dust from the shading device. The final design solution consisted of a winged radiator shading system with a rail support structure and a scissors mechanism for deployment. The total radiator area required was calculated to be 389 sq m for the 10 kW heat rejection system and 973 sq m for the 25 kW heat rejection system. Author

N93-18029# Dayton Univ. Research Inst., OH.
HELMET-MOUNTED AREA-OF-INTEREST DISPLAY Final Report, Oct. 1990 - Mar. 1991
GEORGE R. KELLY, MARTIN SHENKER, and PAUL WEISSMAN Oct. 1992 37 p
(Contract F33615-90-C-0005)
(AD-A258275; AL/HRA-TR-1992-0119) Avail: CASI HC A03/MF A01

This report describes the results of a design study for a helmet-mounted display (HMD) for use as an area of interest (AOI) for the Display for Advanced Research and Training (DART). The objective of the research was to investigate alternative optical approaches for building a helmet-mounted area of interest (HMAOI) for the DART and to recommend the optimal approach based on performance and cost tradeoffs. The experiment examined several system design problems: the design of an HMD eyepiece with minimal obtrusiveness, visual blending of the HMD imagery with the projected imagery, and timing and perspective issues relating to the computer-generated imagery presented by both the HMD and the projection display. GRA

N93-18035# Massachusetts Inst. of Tech., Cambridge.
DESIGN REQUIREMENTS FOR FORCE REFLECTING MASTER CONTROLLERS
M. SRINIVASSEN 2 Nov. 1992 14 p
Avail: CASI HC A03/MF A01

The design criteria imposed by the capabilities of the human user on the design of force reflecting controllers for hands and arms are discussed. This paper contains four sections. First, we present a framework of questions regarding human capabilities. Second, a subset of the criteria is selected as the critical task set. Third, values for this task set are either presented or engineering experiments for determining the values are given. Lastly, the relationship between the critical task set and the engineering specifications for the machine are given. The framework discusses in a broad way all of the kinesthetic, kinematic, and tactile capabilities of the human hand and arm. A machine which met or exceeded all of these capabilities would present a true virtual reality interface. Many of these criteria cannot be met with current technologies. Therefore, the critical sensing/actuation dimensions for performing a set of tasks on a task board must be determined. We present a hypothesized set of criteria based on experience and the literature, and discuss some simple experiments that can be used to clarify the selection. For all of the capabilities, we present values that are available in the literature. The source of each value is referenced, and the experiment is briefly summarized and critiqued. For critical capabilities with unknown values, we have designed some engineering experiments to determine the values. In the design of the machine, only a subset of the human capability criteria are important in determining engineering design specifications. For instance, force threshold without any bias load determines the maximum reflected force that the mechanism can apply in free motion mode. This in turn determines the friction that can be tolerated in the design. We present the important engineering design parameters, and show how these can be determined from the human capabilities. Author

N93-18111*# Bionetics Corp., Cocoa Beach, FL.
CHARACTERIZATION OF THE WATER SOLUBLE COMPONENT OF INEDIBLE RESIDUE FROM CANDIDATE CELSS CROPS
JAY GARLAND Dec. 1992 21 p

(Contract NAS10-11624)
(NASA-TM-107557; REPT-92-TM-02; NAS 1.15:107557) Avail: CASI HC A03/MF A01

Recycling of inorganic nutrients required for plant growth will be a necessary component of a fully closed, bioregenerative life support system. This research characterized the recovery of plant nutrients from the inedible fraction of three crop types (wheat, potato, and soybean) by soaking, or leaching, in water. A considerable portion of the dry weight of the inedible biomass was readily soluble (29 percent for soybean, 43 percent for wheat, and 52 percent for potato). Greater weight loss from potato was a result of higher tissue concentrations of potassium, nitrate, and phosphate. Approximately 25 percent of the organic content of the biomass was water soluble, while the majority of most inorganic nutrients, except for calcium and iron, were recovered in the leachate. Direct use of the leachates in hydroponic media could provide between 40-90 percent of plant nutrient demands for wheat, and 20-50 percent of demand for soybean and potato. Further evaluation of leaching as a component of resource recovery scheme in a bioregenerative system requires study of (1) utilization of plant leachates in hydroponic plant culture; and (2) conversion of organic material (both soluble and insoluble) into edible, or other useful, products. Author

N93-18113*# Texas Univ., Austin.
CONCEPTUAL DESIGN OF A THERMAL CONTROL SYSTEM FOR AN INFLATABLE LUNAR HABITAT MODULE Final Report
KETAN GADKARI, SANJAY K. GOYAL, and JOSEPH VANNIASINKAM 1991 238 p
(Contract NASW-4435)
(NASA-CR-192014; NAS 1.26:192014) Avail: CASI HC A11/MF A03

NASA is considering the establishment of a manned lunar base within the next few decades. To house and protect the crew from the harsh lunar environment, a habitat is required. A proposed habitat is an spherical, inflatable module. Heat generated in the module must be rejected to maintain a temperature suitable for human habitation. This report presents a conceptual design of a thermal control system for an inflatable lunar module. The design solution includes heat acquisition, heat transport, and heat rejection subsystems. The report discusses alternative designs and design solutions for each of the three subsystems mentioned above. Alternative subsystems for heat acquisition include a single water-loop, a single air-loop, and a double water-loop. The vapor compression cycle, vapor absorption cycle, and metal hydride absorption cycle are the three alternative transport subsystems. Alternative rejection subsystems include flat plate radiators, the liquid droplet radiator, and reflux boiler radiators. Feasibility studies on alternatives of each subsystem showed that the single water-loop, the vapor compression cycle, and the reflux boiler radiator were the most feasible alternatives. The design team combined the three subsystems to come up with an overall system design. Methods of controlling the system to adapt it for varying conditions within the module and in the environment are presented. Finally, the report gives conclusions and recommendations for further study of thermal control systems for lunar applications. Author

N93-18153*# Texas Univ., Austin. Dept. of Aerospace Engineering.
SHARC: SPACE HABITAT, ASSEMBLY AND REPAIR CENTER
TODD COLANGELO, DEBORA HOETGER, ADDISON KUO, MICHAEL LO, LELAND MARCUS, PHILIP TRAN, CHRIS TUTT, CHAD WASSMUTH, and GREGORY WILDGRUBE 15 May 1992 136 p Sponsored in cooperation with USRA
(Contract NASW-4435)
(NASA-CR-192031; NAS 1.26:192031) Avail: CASI HC A07/MF A02

Integrated Space Systems (ISS) has taken on the task of designing a Space Habitat, Assembly and Repair Center (SHARC) in Low Earth Orbit to meet the future needs of the space program. Our goal is to meet the general requirements given by the 1991/1992 AIAA/LORAL Team Space Design competition with an emphasis on minimizing the costs of such a design. A baseline structural configuration along with preliminary designs of the major subsystems was created. Our initial mission requirements, which were set by AIAA, were that the facility be able to: support simultaneous assembly of three major vehicles; conduct assembly operations and minimal extra vehicular activity (EVA); maintain orbit indefinitely; and assemble components 30 feet long with a 10 foot diameter in a shirtsleeve environment. Author

N93-18156*# Wisconsin Univ., Milwaukee. Space Architecture Design Group.
PAX PERMANENT MARTIAN BASE: SPACE ARCHITECTURE FOR THE FIRST HUMAN HABITATION ON MARS, VOLUME 5
JANIS HUEBNER-MOTHS, JOSEPH P. FIEBER, PATRICK J. REBHOLZ, KERRY L. PARULESKI, and GARY T. MOORE, ed. 24 Jun. 1992 83 p *Its* Space Architecture Monograph Series
(Contract NASW-4435)
(NASA-CR-192042; NAS 1.26:192042) Avail: CASI HC A05/MF A01

America at the Threshold: Report of the Synthesis Group on America's Space Exploration Initiative (the 'Synthesis Report,' sometimes called the Stafford Report after its astronaut chair, published in 1991) recommended that NASA explore what it called four 'architectures,' i.e., four different scenarios for habitation on Mars. The Advanced Design Program in Space Architecture at the University of Wisconsin-Milwaukee supported this report and two of its scenarios--'Architecture 1' and 'Architecture 4'--during the spring of 1992. This report investigates the implications of different mission scenarios, the Martian environment, supporting technologies, and especially human factors and environment-behavior considerations for the design of the first permanent Martian base. The report is comprised of sections on mission analysis, implications of the Martian atmosphere and geologic environment, development of habitability design requirements based on environment-behavior and human factors research, and a full design proposed (concept design and design development) for the first permanent Martian base and habitat. The design is presented in terms of a base site plan, master plan based on a Mars direct scenario phased through IOC, and design development details of a complete Martian habitat for 18 crew members including all laboratory, mission control, and crew support spaces. Author

N93-18200# Naval Aerospace Medical Research Lab., Pensacola, FL.
TOWARD THE IDEAL MILITARY AVIATION SUNGLASS
J. S. MARSH (University of West Florida, Pensacola.), W. B. CUSHMAN, and L. A. TEMME Nov. 1991 28 p
(AD-A258200; NAMRL-1365) Avail: CASI HC A03/MF A01

Sunglasses and sunvisors affect vision, but can they actually improve it? The effects of sunglasses on vision were modeled considering: (1) Duntley and Middelton's theoretical treatment of the propagation of light through the atmosphere; (2) the dependence of light scatter on wavelength; (3) Blackwell's extensive 'Tiffany' data base describing human visual sensitivity to incremental, contrasting spot stimuli; and (4) human spectral sensitivity. With these factors, sunglass and visor characteristics were identified that maximize the range for detection of small objects. The ideal sunglass or visor thus identified increases the range at which objects can be detected by an average of 5 percent compared to the naked eye. By comparison, the standard 12 filter neutral filter currently used for aviator sunglasses decreases naked eye range by about 5 percent. This paper provides a theoretical framework that could be used in the design and evaluation of sunglasses and visors in environments where vision is critical. GRA

N93-18293# Naval Aerospace Medical Research Lab., Pensacola, FL.
USING CONSTRAINT SATISFACTION NETWORKS TO STUDY AIRCREW SELECTION FOR ADVANCED COCKPITS Interim Report, Oct. 1990 - Jan. 1991

DAVID J. BLOWER Jan. 1992 18 p
(Contract NR PROJ. MM3-3-P-30)
(AD-A258151; NAMRL-SR92-1) Avail: CASI HC A03/MF A01

Pilot selection techniques for the U.S. Navy must meet the challenges offered by the next generation of aircraft. One specific technological advance is likely to be the introduction of machine intelligence into the cockpit to assist pilots in their assigned tasks. We presently do not have any psychological tests in our selection toolkit to measure the cognitive skills needed to interact optimally with machine intelligence. This research has the goal of developing psychological tests, together with the accompanying mathematical models, to measure individual differences in pilot candidates with regard to cooperative human-machine problem solving. The groundwork for a constraint satisfaction network (CSN) approach to cooperative human-machine problem solving was laid down. The details and terminology of a simple CSN were explained. An algorithm to calculate the minimum energy of a CSN was explored in great depth. This algorithm is important because it is the basis for a numerical solution to the mathematical model underlying the CSN. GRA

N93-18517*# Georgia Inst. of Tech., Atlanta. Center for Human-Machine Systems Research.
COGNITIVE ENGINEERING MODELS IN SPACE SYSTEMS Semiannual Status Report Nos. 3 - 5, 30 Jun. 199 1 - 31 Dec. 1992
CHRISTINE M. MITCHELL 15 Dec. 1992 48 p
(Contract NAG9-422)
(NASA-CR-192001; NAS 1.26:192001) Avail: CASI HC A03/MF A01

NASA space systems, including mission operations on the ground and in space, are complex, dynamic, predominantly automated systems in which the human operator is a supervisory controller. The human operator monitors and fine-tunes computer-based control systems and is responsible for ensuring safe and efficient system operation. In such systems, the potential consequences of human mistakes and errors may be very large, and low probability of such events is likely. Thus, models of cognitive functions in complex systems are needed to describe human performance and form the theoretical basis of operator workstation design, including displays, controls, and decision support aids. The operator function model represents normative operator behavior-expected operator activities given current system state. The extension of the theoretical structure of the operator function model and its application to NASA Johnson mission operations and space station applications is discussed. Author

N93-19039*# Iowa State Univ. of Science and Technology, Ames. Dept. of Chemical Engineering.
SPACE LIFE SUPPORT ENGINEERING PROGRAM Semiannual Progress Report, Jul. - Dec. 1991
RICHARD C. SEAGRAVE Dec. 1991 4 p
(Contract NAG2-722)
(NASA-CR-192188; NAS 1.26:192188) Avail: CASI HC A01/MF A01

This report covers the first six months of work performed under the NASA University Grant awarded to Iowa State University to perform research on two topics relating to the development of closed-loop long-term life support systems. A comprehensive study to develop software to simulate the dynamic operation of water reclamation systems in long-term closed-loop life support systems is being carried out as part of an overall program for the design of systems for a Mars voyage. This project is being done in parallel with a similar effort in the Department of Chemistry to develop durable accurate low-cost sensors for monitoring of trace chemical and biological species in recycled water supplies. Aspen-Plus software is being used on a group of high-performance workstations to develop the steady state descriptions for a number of existing technologies. Following completion, a dynamic simulation package will be developed for determining the response of such systems to changes in the metabolic needs of the crew and to upsets in system hardware performance. Author

N93-19104*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EFFECT OF CONTRAST ON HUMAN SPEED PERCEPTION
LELAND S. STONE and PETER THOMPSON (York Univ., England) Dec. 1992 22 p
(Contract RTOP 199-16-12-37)
(NASA-TM-103898; A-91244; NAS 1.15:103898) Avail: CASI HC A03/MF A01

This study is part of an ongoing collaborative research effort between the Life Science and Human Factors Divisions at NASA ARC to measure the accuracy of human motion perception in order to predict potential errors in human perception/performance and to facilitate the design of display systems that minimize the effects of such deficits. The study describes how contrast manipulations can produce significant errors in human speed perception. Specifically, when two simultaneously presented parallel gratings are moving at the same speed within stationary windows, the lower-contrast grating appears to move more slowly. This contrast-induced misperception of relative speed is evident across a wide range of contrasts (2.5-50 percent) and does not appear to saturate (e.g., a 50 percent contrast grating appears slower than a 70 percent contrast grating moving at the same speed). The misperception is large: a 70 percent contrast grating must, on average, be slowed by 35 percent to match a 10 percent contrast grating moving at 2 deg/sec (N = 6). Furthermore, it is largely independent of the absolute contrast level and is a quasilinear function of log contrast ratio. A preliminary parametric study shows that, although spatial frequency has little effect, the relative orientation of the two gratings is important. Finally, the effect depends on the temporal presentation of the stimuli: the effects of contrast on perceived speed appears lessened when the stimuli to be matched are presented sequentially. These data constrain both physiological models of visual cortex and models of human performance. We conclude that viewing conditions that effect contrast, such as fog, may cause significant errors in speed judgments. Author

N93-19464*# North Carolina Agricultural and Technical State Univ., Greensboro. Human-Machine Systems Engineering Lab.
MODELING HUMAN RESPONSE ERRORS IN SYNTHETIC FLIGHT SIMULATOR DOMAIN
CELESTINE A. NTUEN *In its* The Center for Aerospace Research: A NASA Center of Excellence at North Carolina Agricultural and Technical State University 12 p 12 Dec. 1992
Avail: CASI HC A03/MF A03

This paper presents a control theoretic approach to modeling human response errors (HRE) in the flight simulation domain. The human pilot is modeled as a supervisor of a highly automated system. The synthesis uses the theory of optimal control pilot modeling for integrating the pilot's observation error and the error due to the simulation model (experimental error). Methods for solving the HRE problem are suggested. Experimental verification of the models will be tested in a flight quality handling simulation. Author

N93-19465*# North Carolina Agricultural and Technical State Univ., Greensboro. Human-Machine Systems Engineering Lab.
MODELING THE PERFORMANCE OF THE HUMAN (PILOT) INTERACTION IN A SYNTHETIC FLIGHT DOMAIN: INFORMATION THEORETIC APPROACH
CELESTINE A. NTUEN *In its* The Center for Aerospace Research: A NASA Center of Excellence at North Carolina Agricultural and Technical State University 12 p 12 Dec. 1992
Avail: CASI HC A03/MF A03

Current advances in computing technology are devoid of formal methods that describe the theories of how information is shared between humans and machines. Specifically, in the domain of human-machine interaction, a common mathematical foundation is lacking. The aim of this paper is to propose a formal method of human-machine (H-M) interaction paradigm from the information view point. The methods presented are interpretation- and context-free and can be used both in experimental analysis as well as in modeling problems. Author

N93-19466*# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Electrical Engineering.
RECOGNITION OF PARTIALLY OCCLUDED THREAT OBJECTS USING THE ANNEALED HOPEFIELD NETWORK
JUNG H. KIM, SUNG H. YOON, EUI H. PARK, and CELESTINE A. NTUEN *In its* The Center for Aerospace Research: A NASA Center of Excellence at North Carolina Agricultural and Technical State University 10 p 12 Dec. 1992
Avail: CASI HC A02/MF A03

Recognition of partially occluded objects has been an important issue to airport security because occlusion causes significant problems in identifying and locating objects during baggage inspection. The neural network approach is suitable for the problems in the sense that the inherent parallelism of neural networks pursues many hypotheses in parallel resulting in high computation rates. Moreover, they provide a greater degree of robustness or fault tolerance than conventional computers. The annealed Hopfield network which is derived from the mean field annealing (MFA) has been developed to find global solutions of a nonlinear system. In the study, it has been proven that the system temperature of MFA is equivalent to the gain of the sigmoid function of a Hopfield network. In our early work, we developed the hybrid Hopfield network (HHN) for fast and reliable matching. However, HHN doesn't guarantee global solutions and yields false matching under heavily occluded conditions because HHN is dependent on initial states by its nature. In this paper, we present the annealed Hopfield network (AHN) for occluded object matching problems. In AHN, the mean field theory is applied to the hybird Hopfield network in order to improve computational complexity of the annealed Hopfield network and provide reliable matching under heavily occluded conditions. AHN is slower than HHN. However, AHN provides near global solutions without initial restrictions and provides less false matching than HHN. In conclusion, a new algorithm based upon a neural network approach was developed to demonstrate the feasibility of the automated inspection of threat objects from x-ray images. The robustness of the algorithm is proved by identifying occluded target objects with large tolerance of their features. Author

N93-19662# H. W. Structures Ltd., Pitsea (England).
OCCUPANT KINEMATICS SIMULATION OF THE KEGWORTH AIR ACCIDENT
R. HAIDAR and N. ROCK *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992
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The use of computer simulation in the investigation of the crash of Boeing 737-400 at Kegworth has highlighted the importance of the technique in aiding the accident and medical investigations. The analysis has shown the importance of adopting a full brace position for crash landing thus offering significant protection against injury. The major value of the study has shown that a unique and definitive estimation of the occupant kinematics and the effects on the crash victims are possible for an aircrash. Author

N93-19665# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). TNO Crash-Safety Research Centre.
OCCUPANT SIMULATION AS AN ASPECT OF FLIGHT SAFETY RESEARCH
J. J. NIEBOER, J. WISMANS, and R. VERSCHUT *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 9 p Sep. 1992
Copyright Avail: CASI HC A02/MF A04

In the field of flight safety research there is a growing interest for mathematical simulation of human response and injuries associated with survivable aircraft accidents. A mathematical tool can be very helpful to evaluate and improve on-board restraint systems or to assess the effectiveness of different seat designs. The passenger brace position, being a human factor, can be evaluated efficiently as well. MADYMO is a well accepted integrated multibody/finite element program for Crash Victim Simulation. Recently the two-dimensional version of MADYMO was successfully applied for reconstruction of seat and passenger behavior during the M1 Kegworth air accident. In this paper a brief description of MADYMO as well as three flight safety applications are presented. Special attention is given to the application concerning a dynamic seat test involving a 50th percentile Hybrid 2 dummy and a greater than P3/4 dummy, representing a nine-month-old child, seated in a child seat. The MADYMO model used for this application was validated on the basis of sled test results. It can be learned that MADYMO is capable of predicting passenger and seat response in an aircraft crash environment. A discussion on future developments in this field concludes this paper. Author

N93-19666# Arup (Ove) and Partners, London (England).
COMPUTER AIDED METHODS FOR SIMULATING OCCUPANT RESPONSE TO IMPACT USING OASYS DYNA3D
T. J. KEER, R. M. V. STURT, and B. D. WALKER *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 16 p Sep. 1992
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Numerical simulation can play a key role in design for crashworthiness and accident investigation. This paper presents recent work in the development of occupant simulation techniques for the automotive industry, and describes how the same techniques may be applied to aircraft crashworthiness. Author

N93-19667# Applied Physics, Inc., Nanuet, NY.
DESIGN/DEVELOPMENT OF AN ENHANCED BIODYNAMIC MANIKIN
PAUL H. FRISCH and WILLIAM BOULAY *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 9 p Sep. 1992
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This publication details the design and development of an enhanced manikin form incorporating all instrumentation and data acquisition capabilities to record and reconstruct the six degree of freedom response of the manikin. The manikin is designed to enhance biofidelity and provided a three dimensional biodynamic response, attempting to approximate that of the human. These objectives resulted in the implementation of an omnidirectional response flexible spine and pelvis assembly. Author

N93-19668# Simula, Inc., Phoenix, AZ.
IMPROVING MANIKIN BIOFIDELITY
CAROLINE VANINGEN-DUNN, MARVIN RICHARDS, and INTS KALEPS (Wright Research Development Center, Wright-Patterson AFB, OH.) *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 14 p Sep. 1992
Copyright Avail: CASI HC A03/MF A04

Two programs demonstrating the feasibility of improving the dynamic response of ejection system test manikins have been completed for the U.S. Air Force. The first program developed a manikin neck that has greater biofidelity during vertical impact conditions than currently available manikin necks. The second program developed manikin arms and legs with proper mass and mass moments of inertia to improve dynamic response. Both programs were conducted to support the development of the U.S. Air Force's Advanced Dynamic Anthropomorphic Manikin (ADAM). Author

N93-19669# Department of Transport (England). Transport Research Lab.
THE DESIGN AND USE OF AUTOMOTIVE CRASH TEST DUMMIES
A. K. ROBERTS *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992
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Anthropomorphic crash test dummies have been used by the automotive industry for many years in order to develop safer road transport. Accident investigations have shown how vehicle design has improved, with the number and severity of road casualty injuries decreasing despite increased use of road transport. Several different types of dummies of differing levels of sophistication are used to approve vehicles to a number of different standards and

regulations. Dummies are used either to approve restraint systems at the component level or in full vehicle impact tests. Various performance criteria must be met by anthropomorphic test dummies, and these criteria are discussed with reference to the interests of the vehicle designer, the biomechanical engineer and the legislative authority. The paper concentrates on the approach to dummy design used to develop the new European Side Impact Dummy EUROSID-1. The methodology used to develop certification techniques is described as well as the dummy itself. Techniques to calibrate a dummy in terms of predicting human injury risk are reviewed. The techniques described are common to all automotive crash test dummies and can be applied to the design and development of anthropomorphic dummies to be used in other disciplines. Author

N93-19670# Biokinetics and Associates Ltd., Ottawa (Ontario).
AN IMPROVED ANTHROPOMETRIC TEST DEVICE
TOM GIBSON, JAMES NEWMAN, JOHN W. ZELLNER (Dynamic Research, Inc., Torrance, CA.), and KENNETH D. WILEY (Dynamic Research, Inc., Torrance, CA.) *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 7 p Sep. 1992
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This paper reviews recent experience with a new test dummy intended principally for use in motorcycle crash testing. Modifications to the Hybrid 3 to better service this particular environment also makes the device potentially suitable in aicraft occupant crash protection assessment. This new ATD contains a 16-channel on-board data acquisition system, lower extremities that are capable of monitoring for leg and knee injuries, a more flexible lumbar spine, a penetration monitoring abdomen, a deformable thorax with improved motion sensing capabilities and a neck with improved flexion and extension bending response. The femur and tibial complex are constructed of frangible elements whose biomechanical responses are based on available cadaver data. The knee is designed with fusible links that fail at load levels commensurate with that of human knee ligaments. The test device has been used in full-scale crash tests as well as limited laboratory validation tests. This paper illustrates the potential of this injury monitoring device for aerospace applications as well as identifying areas of future work. Author

N93-19671# Royal Netherlands Air Force, Volkel. Inst. of Aviation Medicine.
THE APPLICATION OF HYBRID 3 DUMMY TO THE IMPACT ASSESSMENT OF A FREE-FALL LIFEBOAT
D. H. GLAISTER, P. J. WAUGH, and L. NEIL *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 6 p Sep. 1992
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A requirement to monitor occupant forces during the launch of a free-fall lifeboat has led to the definition of a transportable instrumented dummy and data-acquisition system. Good quality data have been recorded during 21 free-falls from which advice has been given concerning the acceptability of launch forces for both injured and non-injured personnel. Head restraint is not considered in the International Maritime Organization's current assessment criteria for free-fall lifeboats, but was shown to have a pronounced effect on head and neck forces, with significant overshoots being seen when no restraint was available. It is concluded that the dummy and data-acquisition system developed for these trials offers a valid means for assessing impact forces and injury risk in novel impact environments such as the launch of a free-fall lifeboat. Author

N93-19672# New Orleans Univ., LA. Naval Biodynamics Lab.
A NEW INSTRUMENTATION SYSTEM FOR MEASURING THE DYNAMIC RESPONSE OF THE HUMAN HEAD/NECK DURING IMPACT ACCELERATION
M. S. WEISS, G. C. WILLEMS, S. J. GUCCIONE, JR., C. J. MUGNIER, and M. E. PITTMAN *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 6 p Sep. 1992
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Recently developed angular motion sensors, based on the laws of magnetohydrodynamics, have potential application in biodynamic research. These sensors were tested on the Naval Biodynamics Laboratory's (NBDL) vertical accelerator, using the Hybrid 3 manikin as the test subject. The sensors were used to measure the manikin's head motion in three dimensions. Experiments were conducted at impact levels up to 13g in the vertical (+Z) direction. Data was collected using both the new sensors and the standard NBDL package of nine linear accelerometers. A new method for obtaining initial position and orientation information using still photogrammetry was also evaluated. The analyses of the tests show that the new sensor and photogrammetry system compared well with the nine accelerometer array and the direct photographic measurement of displacement. Comparisons were made between measurements of acceleration, velocity and displacement. The new system yielded equivalent and, in some instances, more accurate results. This study extends the results of previous preliminary testing and confirms the value of the new system as a simpler, more accurate and portable replacement for the old one. Author

N93-19699# Spanish Air Force, Talavera AFB. Flight Surgeon.
AN EPIDEMIOLOGICAL STUDY IN SAF'S PILOTS EJECTIONS
J. L. GARCIA ALCON, M. R. DURAN TEJEDA (Extremadura Univ., Badajoz, Spain), and J. M. MORENO VAZQUEZ (Extremadura Univ., Badajoz, Spain) *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 8 p Sep. 1992
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Aircraft escape systems - the ejection seat - have saved a lot of lives, however they often have several secondary problems. First, the physical injuries directly produced by the ejection itself; and secondly, the psychological alterations caused by the fact of suffering from an aircraft accident. This study has been made to get more data on ejections raised in some Spanish Air Force pilots in order to correct the possible mistakes in further ejections. The most remarkable results are: First, the importance of performing the ejection within the safety limits of the seat, and with a very good sitting posture, to minimize possible injuries. Secondly, the necessity for both ejection seat simulator and parachute training of pilots since most injuries are generated when the pilot has a wrong sitting posture and when he lands on the ground. And finally, the quick incorporation to flying duties as soon as the ejected pilot accomplished his total recovery. Author

N93-19704# Institute of Aviation Medicine, Oslo (Norway).
THE NEXT GENERATION FEMALE IN COCKPIT: DO WE NEED A NEW APPROACH TO COCKPIT RESOURCE MANAGEMENT (CRM)?
G. MYHRE and J. E. JANSEN *In* AGARD, Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques 3 p Sep. 1992
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Several aviation accidents are caused by inadequate or misinterpreted communication within the crew or between cockpit and ATC. The present pilot training put more highlight on personality attitudes that favor crew coordination in addition to technical expertise than earlier days. This may imply that cultural differences more easily will emerge and have to be taken into training considerations instead of more or less ignoring them as was possible when the operational performance proficiency was all that really mattered for the professional pilot. With more females entering pilot training one should accept that the two sexes emerge from different training strategies, especially within crew resource management training may work more effectively than it has up till now. I.I.C.

N93-19757# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
ADVANCED AIRCRAFT INTERFACES: THE MACHINE SIDE OF THE MAN-MACHINE INTERFACE [LES INTERFACES SUR LES AVIONS DE POINTE: L'ASPECT MACHINE DE L'INTERFACE HOMME-MACHINE]
Oct. 1992 296 p In ENGLISH and FRENCH Symposium held in Madrid, Spain, 18-22 May 1992
(AGARD-CP-521; ISBN-92-835-0689-8) Copyright Avail: CASI HC A13/MF A03

This Symposium explored the use of three of man's senses (sight, hearing, touch) to improve the man-machine interface in the cockpit. The seven sessions included Defining Concepts and Design Issues, Maintenance for Advanced Cockpit Systems, Panoramic and Virtual Cockpits, Helmet Mounted Displays, Voice Technology, System Design Concepts and Tools, and finally Device Technologies. As the demands placed upon the aircrew by the modern battlefield continue to increase, this Symposium attempted to effectively blend the technologies available to decrease the workload.

N93-19758# Technische Univ., Twente (Netherlands). Computer Vision Lab.
ENGINEERING THE VISIBILITY OF SMALL FEATURES ON ELECTRONIC FLIGHT DISPLAYS
D. BOSMAN *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 7 p Oct. 1992
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The applications and limitations of high resolution afforded by modern display technologies are discussed, in relation to the properties of the human visual system; and how much 'engineering' may become possible early in the design phase by the use of model(s) of the 'visual system - technology interface' (VSTI). Display technology models provide good predictions of the distributions of luminance, color, and contrast under specified driving and environmental conditions. Coupled to suitable vision models, estimates of visibility of pattern details can be made. In VSTI models, the beholder of the imagery is regarded as a detector responding to displayed pattern with 'yes', 'no', or even be allowed fuzzy and false responses. Some conclusions are given concerning design of pattern details in imagery, given the characteristics of the display and of the observer. Author

N93-19759# Naval Air Warfare Center, China Lake, CA. Aircraft Weapons Integration Dept.
HUMAN FACTORS PROBLEMS FOR AIRCREW-AIRCRAFT INTERFACES: WHERE SHOULD WE FOCUS OUR EFFORTS?
JUDITH H. LIND and CAROL G. BURGE *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 12 p Oct. 1992
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Twenty eight problem areas where human factors engineers lack the information needed for development of crewstations for advanced military fighter and attack aircraft are identified and discussed. Emphasis is on naval air missions projected during the early 21st century against land and sea-surface targets. The 28 problem areas are based on the functions that the crews must carry out for successful mission accomplishment. Human capabilities and limitations documented in the human factors literature that relate to these aircrew functions were used to define the problem areas. The goal is to ensure that aircrew performance will be satisfactory for anticipated air missions. The 28 problem areas are grouped into nine human factors problem categories. For each category, the human factors knowledge and man-machine interface engineering capabilities that should be extended during this decade are noted. The human factors problem categories are (1) physical and physiological stress, (2) vigilance and aircrew alerting, (3) individual differences, (4) information integration, (5) visual displays for various missions, (6) mission management, (7) decision support, (8) automation, and (9) system design and evaluation. Author

N93-19760# Telefunken System Technik G.m.b.H., Wedel (Germany). Aircraft Equipment.
ADVANCED COCKPIT-MISSION AND IMAGE MANAGEMENT
JUERGEN STRUCK, ed. *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 15 p Oct. 1992
Copyright Avail: CASI HC A03/MF A03

Modern cockpit designs require new modular architectures for mission and image-management with regards to hardware and software aspects. The main task is the collection of aircraft specific data using the appropriate data management, the transformation of such data to graphical images with the appropriate logical image management, the generation of physical graphical images on several image devices by physical image management and the conversion and combination/mixing of physical graphical data with the data, created by external video sensors using video management. Finally the video-data has to be presented on several devices, like head down-, head up-, and helmet mounted displays. The main goal for us as basic system supplier is to give the application programmer an abstract high-level interface for all these functions. This is to be done and is specially supported by the program language Ada, which is the required language for military and civil aircraft applications. The system described herein was developed for the German experimental helicopter program AVT and two special applications for the X31A experimental aircraft. Author

N93-19761# British Aerospace Aircraft Group, Brough (England). Kingston Military Aircraft Ltd.
AIRCREW ACCEPTANCE OF AUTOMATION IN THE COCKPIT
MARK HICKS and IAN ROSS (British Aerospace Aircraft Group, Kingston-upon-Thames, England) *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 5 p Oct. 1992
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The concept of human-electronic co-operation in the cockpit is synonymous with that of a team. Whether or not team members interact effectively will rely largely upon the pilot's acceptance of his electronic team mate. This paper reports on the attitudes of eight British Aerospace test pilots towards the future of such co-operation. Particular emphasis is laid upon the factors of system function, task allocation, and trust. Pilots opinions are examined against a schema of 'Operational Relationships', recently proposed in the literature. Author

N93-19762# Rome Lab., Griffiss AFB, NY. Systems Reliability Div.
TIME STRESS MEASUREMENT DEVICES FOR ENHANCEMENT OF ONBOARD BIT PERFORMANCE
LEONARD J. POPYACK, MARK E. MCCALLUM, and JAMES A. COLLINS *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 6 p Oct. 1992
Copyright Avail: CASI HC A02/MF A03

An important aspect of a pilots situational awareness is the need for accurate real time information on the operational status of all aircraft systems. False and intermittent indications have been a problem with many of the built-in-test (BIT) functions in aircraft systems. These indications result in Retest OK (RTOK) and Cannot Duplicate (CND) maintenance events when the aircraft returns. These types of events account for 35 percent to 65 percent of the indicated faults in many Air Force avionics systems. Any false indications put an unnecessary and potentially fatal burden on the pilot during the operational scenario and also consume significant maintenance resources. Many of these false alarms and intermittent status indications are related to the environmental conditions present at the time of the indication. Time Stress Measurement Device (TSMD) technology offers a means of providing this crucial environmental information to the system's BIT. TSMD's are digital environmental measurement and recording devices in a microelectronic package which can be embedded into a system at the time of manufacture or on a retrofit basis. The information collected and provided by the TSMD can be provided in real time for the on-board BIT to try and discriminate between transient

system performance anomalies and hard failures. Thus, only accurate performance status information is reported to the pilot. The paper describes the background of TSMD development, current state-of-the-art in TSMD hardware and software, current applications which address the enhancement of on-board BIT performance, and future thrusts in the TSMD area. Author

N93-19764# Air Force Wright Research and Development Center, Wright-Patterson AFB, OH. Advanced Technology Integration Office.

DEVELOPING VIRTUAL COCKPITS

WAYNE L. MARTIN *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 8 p Oct. 1992

The motivation for development of virtual crew system technologies stems from the growing complexity of cockpit interfaces and the realization that humans are spatial beings who are much better equipped to process and control information if it bears a spatial and temporal relationship to the way the real world exists at the moment. The virtual cockpit will provide three-dimensioanl (3-D) spherical awareness, intuitive control interfaces, and automated assistance to the pilot. Three-dimensional visual and auditory information will be presented via the pilot's helmet, while tactile information may be presented through micro-stimulators within the pilot's glove, which are activated as a function of hand and/or finger position within the cockpit. The intent is to build a virtual cockpit that creates a representation of the look and feel of the real world, to the extent that the interaction with the display and control of information is as natural as possible. The notion of a virtual cockpit has been popularized in the 'Super Cockpit' concept. The Super Cockpit concept demands a functional integration of a broad range of advanced control, display, and avionic technologies. The successful marriage of the individual capabilities that each of these technologies represent demands an understanding and appreciation of the requirements for sensing, processing, and displaying information to provide the pilot the advantage of 3-D spatial/situational awareness throughout the mission. The multifaceted development issues associated with realization of the virtual cockpit are addressed. Author

N93-19765# Wright Research Development Center, Wright-Patterson AFB, OH. Wright Lab.

PANORAMIC COCKPIT DISPLAYS

DARREL G. HOPPER *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 25 p Oct. 1992

The great challenge of today's cockpit designers is to provide the 21st century pilot the necessary situation awareness to be effective in combat. This situation awareness is difficult to achieve because a pilot has to look at numerous dials and indicators, multiple small displays with different range scales and ownship locations, and distorted radar images. Today the pilot must fuse all information and be able to make immediate critical decisions in a combat environment. Part of the solution to this information overload problem is a panoramic agile-window display. The advantages of a large area display system were recently demonstrated in the Panoramic Cockpit Control and Display System research program. The principal objective result was a 45 percent increase in pilot combat effectiveness. The key to the implementation of the panoramic cockpit concept is a large area display together with a helmet-mounted equivalent of the present day head-up display. The large area head down system uses direct view or projected view to create an aggregate display area of 650-2000 sq cm. The status of cockpit displays is reviewed with an emphasis on hardware. Several technologies are being developed simultaneously and are analyzed here against requirements of our cockpit visions for new systems such as the F-22 and RAH-66, retrofit programs like the C-130/C-141, and advanced fighter and transport concepts. Author

N93-19766# Dassault-Breguet Aviation, Saint Cloud (France).

FLIGHT ABOVE A VIRTUAL WORLD [VOL AU-DESSUS D'UN MONDE VIRTUEL]

P. LARROQUE and R. JOANNES *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 11 p Oct. 1992 In FRENCH

Research for stealth methods of low level penetration flight leads us to consider the use of terrain data bases which are becoming more and more easily available. This is why the French Ministry of Defence has granted DASSAULT AVIATION a contract in the scope of the APIS Exploratory Program. The purpose of this study was to consider the use of terrain files for designing synthetic images intended for combat aircraft. The aim is to provide the pilot with pictures replacing direct sight on the outside world, thus helping him to conduct the flight by any weather or at night. The research for this new concept was supported by intensive software development on real time simulation tools. The latter permitted the proposal of different APIS representations for both head-up and head-level displays. The process followed during the elaboration of the images with the active participation of the French Officials is presented. We also give some examples of proposed pictures. At the end of the study these proposals were assessed by a team of ten military pilots, belonging either to flight test teams or coming from French Navy and Air Force. This evaluation has been carried out by the CERMA (French Aero-Medical Research Institute). However, many points are still to be examined: how to display these pictures onboard while managing safety and limiting costs and resources consumption at an affordable level. Author

N93-19767# Delft Hydraulics Lab. (Netherlands). Delft Instruments Electro Optics.

A NEW CONCEPT FOR HELMET MOUNTED VISION

G. DEVOS, D. M. A. BROEKMANS, and R. P. SLEGTENHORST *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 10 p Oct. 1992

Successful applications of holographic optical elements (HOE's) in the holographic night vision goggles have led to interesting developments of new concepts for helmet mounted vision systems. The present application of HOE's in night vision goggles is discussed, as well as a new concept of Helmet Mounted Vision Systems. Author

N93-19769# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.

THE MOD (UK) INTEGRATED HELMET TECHNICAL DEMONSTRATOR PROGRAMME

A. KARAVIS and T. H. SOUTHAM (Ministry of Defence, London, England) *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 10 p Oct. 1992

As a result of progressively adding on capabilities to the basic protective flying helmet, present solutions to operational requirements result in barely acceptable flying helmet assemblies. The devices which provide these capabilities must all be compatible with each other, with the rest of the pilot's Aircrew Equipment Assembly (AEA), and with the aircraft. Often conflicting requirements result in compromises being made. Fundamental rules of optics cannot be changed, and in general, improved optical performance results in larger, heavier head-borne load. Heretofore, the solutions were engineered by several companies, each specializing in a particular discipline, resulting in the present 'add-on' philosophy. The UK MOD has taken the view that the time is appropriate for industry to adopt a more coordinated approach. The Integrated Helmet Technical Demonstrator Program (IHTDP) is aimed at encouraging a helmet to be designed from the outset with wide ranging capabilities, stimulating industry to form consortia to produce a truly integrated helmet. The background to the program and the requirements from the operators' point of view are discussed and the specification of requirements are described. Author

N93-19770# Pilkington P.E. Ltd., Saint Asaph (Wales).
MULTI-FUNCTION VISOR
J. FOLEY and A. T. HEAD *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 3 p Oct. 1992
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A multitude of new roles are required for future aircrew visors. Large numbers of visors on a single helmet is not an acceptable solution. There is therefore a requirement for Multi-Function Visors which perform numerous roles. Many of the optical protective functions carry an unavoidable loss of visual transmittance. When these are combined, the overall visual transmittance may typically be 40 percent or lower. These functions therefore need to be combined on an outer Multi-Function Visor which the pilot can deploy at will. A permanent inner clear visor will provide all the mechanical protection and will also host the HMD combiner. A suite of outer MFV's may be required to cover all the combinations of laser threats in the visible, with the appropriate visor being selected for each mission. Author

N93-19772# Lernout and Hauspie Speech Products N.V., Ypres (Belgium).
THE USE OF VOICE PROCESSING FOR SOME ASPECTS OF THE PILOT-VEHICLE-INTERFACE IN AN AIRCRAFT
FERNAND HOLLEVOET and CHRISTIAN J. WELLEKENS *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 7 p Oct. 1992
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The challenges that lie in the development and design of a pilot vehicle interface (PVI), both in the basic voice processing technologies as in the robustness requirements of the system, due to the peculiar circumstances in which it has to be used, are described. Furthermore, we will focus on the state of the art, and on the results of the current R&D efforts within Lernout and Hauspie Speech Products on both the recognizer itself as well as its robustness, and also the hardware implementation. At the end, we will dip into the future and look at the continuing R&D efforts both to enhance the available algorithms and to undertake new basic efforts in the area of application. Author

N93-19773# Sextant Avionique, Valence (France).
MULTIMODAL DIALOG SYSTEM FOR FUTURE COCKPITS [SYSTEME DE DIALOGUE MULTIMODAL POUR COCKPITS FUTURS]
J.-N. PERBET, J.-J. FAVOT, and B. BARBIER *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 3 p Oct. 1992 In FRENCH
Copyright Avail: CASI HC A01/MF A03

The display devices of the future will call upon multimedia systems allowing a multimode dialogue between the man and the system. We describe the concept of a large interactive screen, built around an image wall in the instrument panel and an assembly of the means of dialog used simultaneously. It will make it possible to reduce the workload of the pilot by an optimization of the dialogue with the system while using, among other things, an intelligent dialogue assisting device. Many studies have been carried out on the isolated use of input-output devices (keyboard, mouse, handle, vocal reconnaissance...), but none presents a global solution of the multimode dialogue in the cockpit. We thus developed and implemented an experimental device to study man-system interactions using the eye, the hand, and the voice. Author

N93-19774# Defence and Civil Inst. of Environmental Medicine, North York (Ontario).
PRINCIPLES FOR INTEGRATING VOICE I/O IN A COMPLEX INTERFACE
M. M. TAYLOR and D. A. WAUGH (Andyne Computing Ltd., Kingston, Ontario) *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 14 p Oct. 1992
Copyright Avail: CASI HC A03/MF A03

The integration of voice into a complex interface like that between a pilot and an aircraft is not trivial. We try to address some of the factors affecting the use and integration of voice in human-machine interfaces. We describe general principles for merging different kinds of human-machine interaction, and apply them to voice interaction in the cockpit. We do this despite published opinion that psychological principles cannot be applied in the design of human-computer interaction. The theory of Layered Protocols (LP) is introduced in context of the more general Perceptual Control Theory of behavior (PCT). LP theory provides a model for describing interaction between complex partners based on a layered structure of protocols that differ in levels of abstraction. The proper use of feedback is fundamental to both LP and PCT. Voice interaction is useful mainly for the control of tasks requiring discrete information. Failure of voice recognition systems is often caused by inappropriate feedback. Providing feedback and forcing correction word by word may increase the mental load on a user, often leading to instability in the interaction. Such inefficient, and often frustrating, use of voice interaction can often be overcome through the use of feedback at higher, more abstract, layers of interaction. Successful adoption of voice interaction depends on allocating the appropriate tasks of communication to the voice protocol, the dynamic modeling of the partner, and the use of higher level protocols to help control potential instability. Author

N93-19775# Sextant Avionique, Valence (France).
G-LOAD EFFECTS AND EFFICIENT ACOUSTIC PARAMETERS FOR ROBUST SPEAKER RECOGNITION
CH. GULLI, D. PASTOR, A. LEGER, P. B. SANDOR, J. M. CLERE (Centre d'Essais en Vol, Bretigny-Air, France), and P. GRATEAU (Centre d'Essais en Vol, Bretigny-Air, France) *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 14 p Oct. 1992
Copyright Avail: CASI HC A03/MF A03

Acoustic features of the speech production with G-load effects were found from the computer signal analysis. Their correlates with physiological features will permit an interpretation of the variability of formant and pitch shifts. The pilot study experiments were conducted by SEXTANT and the LAMAS (Laboratoire de Medecine aerospatiale). Six subjects participated in the experiment. Their mean age was 30 years. A series of experiments in centrifuge environment were performed as part of a research program. A specific vocabulary was made for the first investigation with speakers in centrifuge. Comparison of spectrographic analysis and wavelet decomposition have permitted to show a spectral pattern modification for recognition process. Due to the accuracy and limitations of the sonograph measurements, we developed multiresolution transforms. A window Fourier transform is better suited for analyzing signals where all patterns appear approximately at the same scale. The old multivariate statistical analysis, after the Bark's transformation, can produce a good projection on the eigenvectors of the correlation matrix. The choice of the eigenvalues seems very easy for seeking the best representation of speech production. An interpretation of the mechanical effects due to the acceleration can be shown with analysis tools. We observed, in agreement with acoustic multi-resolution analyses, that producing speech in G-load conditions can increase energy, pitch, and formant frequency locations. The influence of the breathing on some parameters is noticeable. The last section discusses the incidence of these results on the robust speech recognizer for military cockpit environment. Author

N93-19776# Naval Air Warfare Center, China Lake, CA. Weapons Div.
A SYSTEMS APPROACH TO THE ADVANCED AIRCRAFT MAN-MACHINE INTERFACE
F. ARMOGIDA *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 13 p Oct. 1992
Copyright Avail: CASI HC A03/MF A03

Current thinking on the aircraft man-machine interface focuses primarily on the cockpit. My proposed approach will view the mission planning/mission rehearsal and the aircraft as an integral system that can perform three functions: (1) dynamically adjust itself to the particular pilot response in the planning/rehearsal

stage, (2) adjust itself during the strike based upon the scenario encountered, and (3) adjust itself after each mission to enhance planning for follow-on missions. The objectives are to improve strike effectiveness and to shift portions of the pilot's work load from the attack to the planning phase of the strike. This concept can be implemented using existing and emergent technologies. Aircraft now coming on line are equipped with removable disks that are used to load mission specific data for the avionics and weapon systems (maps, ELINT files, route plans, navigation data, target coordinates, etc.). Mission planning systems are being configured not only to provide these data, but also to evaluate post flight data from flight recorders. Mission planning and rehearsal with the resulting aircraft mission data package will provide more inputs for the aircraft mission computer that will eventually fly the mission. Inter-aircraft computer communications will support adaptively optimizing the strike based upon the threat and target conditions encountered and the success of the strike to that point in time (adaptive mission control). Pilot intervention may only be required for aircraft-to-aircraft combat, freeing the pilot to attend to weapon aimpoint selection tasks (where the automatic systems have low confidence in their selections) or for unplanned contingencies. The mission planning/aircraft system, the notional aircraft avionics for adaptive mission control, and the implications for the man-machine interface are described. Author

N93-19777# *Royal Air Force, Farnborough (England). Mission* Management Aid Project.
MANAGEMENT OF AVIONICS DATA IN THE COCKPIT
E. J. LOVESEY *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 5 p Oct. 1992
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The rapid developments in avionics and the associated processing power now available in aircraft have produced cockpit systems which can quickly saturate the crew with information. Only by understanding man's capabilities and limitations will it be possible to design integrated avionics systems which match man's requirements and result in an effective man-machine combination. Only by paying great attention to management of the information flow between aircrew and avionics systems will it be possible to optimize the man-machine system in future combat aircraft. Examples of past problems and current developments in the management of data flow in the cockpit are given. Author

N93-19778# Smiths Industries Ltd., Bishops Cleeve (England).
MODEL-BASED REASONING APPLIED TO COCKPIT WARNING SYSTEMS
C. R. OVENDEN *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 7 p Oct. 1992
Copyright Avail: CASI HC A02/MF A03

With the advances in display technology and the increasing use of software control, more information in the modern commercial aircraft cockpit is available on request only instead of continually. Furthermore, the reduction in crew size has resulted in a reduction in the routine monitoring of system parameters. However, advances in sensory capability are enabling far more system parameters to be measured. The combination of these trends leads to the perception by the aircrew of an abrupt transition from normal operation to the need to deal with system malfunction. Work undertaken to maximize the use of available information in order to maintain the aircrew's awareness of the status of the aircraft's systems and to provide advice in the advent of malfunction or abnormality is outlined. The appropriate carrier of such information is the modern centralized cockpit warning systems. Author

N93-19779# British Aerospace Aircraft Group, Preston (England). Military Aircraft Div.
THE INTEGRATION OF ADVANCED COCKPIT AND SYSTEMS DESIGN
P. R. WILKINSON *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 9 p Oct. 1992
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The way in which typical operational scenarios that are representative of future conflict impact on the specification and design for man/machine performance is examined. Operational Requirements for aircraft to survive and deliver the goods in this context present a tremendous challenge to the Prime Weapon System Contractor. Military procurement agencies have long been striving to realize increased weapon system performance from dwindling resources. Thus current initiatives such as MANPRINT have been launched to change an equipment-oriented view of system development towards a broader view that considers hardware, software, and operator together as a system. It is argued that unless the piloting function and system integration tasks are considered as an integral part of the design process from day one, a less than optimum design will always result. It is recommended that a structured top-down design methodology be employed that translates Operational Requirements into piloting and system functions at one and the same time. An overview is given of use of just such a design process developed at BAe Warton, with particular reference to the European Fighter Aircraft (EFA) project. The various stages of the design process are explained and indications given of current progress of EFA. Emphasis is given to the tools and methods used to ensure that a highly integrated system and advanced cockpit design are successfully achieved. Author

N93-19780# Elektronik-System G.m.b.H., Munich (Germany).
CVA, COCKPIT DESIGN AND DEVELOPMENT TOOL
CHRISTOPH WEBER *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 5 p Oct. 1992
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The conceptual design and development of a modern helicopter cockpit requires the consideration of ergonomic, operational, and technical aspects. New and additional technologies lead to a steady increase of data and workload, so that an essential task is to obtain an optimum layout of the 'Man-Machine-Interface' (MMI). For the performance of this task, MoD has charged ESG to generate a national Cockpit Design Tool CVA and to operate it in parallel with the TIGER development. Due to the national character of the CVA those tasks are primarily handled which concern the specific German portion of the TIGER program, e.g. the control and display system of the digital map generator, the helmet-mounted sight/display system, and the HF data link. These complex systems, however, cannot be investigated separately due to the multiple reciprocal actions with the remaining display and control systems, but have to be considered with the overall cockpit. Thus the CVA is the reproduction of a functioning 1:1 cockpit of the PAH2 version of the TIGER and is operated in close cooperation with the future user (pilot). It is a closed-loop simulator which enables the checking of important areas of the MMI not only in theory, but mainly under practical conditions long before a prototype of the new helicopter exists. Author

N93-19781# Naval Air Warfare Center, China Lake, CA. Aircraft Weapons Integration Dept.
MAN-MACHINE INTERFACE WITH SIMULATED AUTOMATIC TARGET RECOGNITION SYSTEMS
MARION P. KIBBE and EDWARD D. MCDOWELL *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 10 p Oct. 1992
Copyright Avail: CASI HC A02/MF A03

Growing numbers of targeting information sources in military cockpits have led to the development of automatic target recognition (ATR) systems. Since initially most ATR's will be used with an operator, a series of experiments was conducted to investigate aspects of the interface between the operator and the ATR. Two experiments are described which measured the speed and accuracy of ship identifications made by an operator using information from an imaging sensor and a simulated ATR. These measures were compared to performance of the unaided operator and to performance of the autonomous ATR. The accuracy of the ATR, the format of its output, and the quality and type of the sensor information was varied in the experiments. The results are discussed in terms of their implications for the design of the operator-ATR interface that will lead to satisfactory system performance. Author

N93-19782# Litton Systems (Canada) Ltd., Rexdale (Ontario).
THE ACTIVE-MATRIX LC HEAD-DOWN DISPLAY (AM-LCD): OPERATIONAL EXPERIENCE AND GROWTH POTENTIAL
J. F. FARRELL, J. C. PRINCE, and J. C. WRIGHT *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 11 p Oct. 1992
Copyright Avail: CASI HC A03/MF A03

After a protracted development period, the active-matrix addressed liquid crystal light valve is finding increasing employment in a variety of head-down primary flight instrument applications. While the packaging efficiencies of such a flat panel technology are self-evident, many of its other attributes are also likely to have a profound impact upon crew station design. In order to successfully exploit the positive aspects of this technology, it is appropriate that the avionics systems architects benefit from the, albeit limited, current operational data base and develop a realistic understanding as to the limits and rate of advancement pertinent to this class of display device. The following paper is offered as an element in this information dissemination process from a source that has maintained a presence in the technology since 1984 and has participated in active-matrix liquid crystal display (AM-LCD) solutions for such diverse air-vechicle requirements as YF-23, LH, P-3C, and C-130. Author

N93-19784# Naval Air Warfare Center, China Lake, CA. Weapons Div.
ADAPTIVE AUTONOMOUS TARGET CUER
CHI-KIN LAM, DANIEL SEARLE, and WAYNE TANAKA *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 8 p Oct. 1992
Copyright Avail: CASI HC A02/MF A03

The Navy is exploring the use of an adaptive autonomous target cuer that is potentially more reliable than existing systems. Variations in the operational environment and target type are major factors that can degrade an autonomous sensor-based cuer performance. The solution presented here is to have several parallel algorithms for each functional component in our target cuer. Each algorithm is tuned to handle a particular situation. Based on certain indicator functions, a fuzzy logic expert system controller will select the most suitable algorithm and optimal parameters to process the sensor data. Although the proposed system is essentially comprised of conventional components such as image preprocessing, feature extraction, and correlation, it distinguishes itself because of its use of fuzzy logic in decision making and its adaptive nature. In designing an expert system, we will select the optimal set of indicator functions using the Taguchi process-control methodology. Preliminary results will be presented. Author

N93-19785# Eurocopter Deutschland G.m.b.H., Munich (Germany).
EQUIPMENT, MORE OR LESS READY TO BE USED IN HELICOPTERS
H. HELLMUTH and H.-D. V. BOEHM *In* AGARD, Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface 6 p Oct. 1992
Copyright Avail: CASI HC A02/MF A03

Examples of equipment taken from project studies and the specific boundary conditions for helicopters are discussed. Avionic equipment, sensors, displays, and controls are covered. Equipment and technologies ready to be used today and in the near future as well as equipment hardly usable are analyzed. Equipment specific characteristics and helicopter/cockpit integration specifics are covered. Author

N93-19917# Aeroplane and Armament Experimental Establishment, Boscombe Down (England).
HELICOPTER NIGHT VISION GOGGLE TESTING IN THE UNITED KINGDOM
MICHAEL R. SWALES and RANDALL W. CASON *In* AGARD, Flight Testing 12 p Oct. 1992
Copyright Avail: CASI HC A03/MF A04

The ominous lethality of the modern battlefield necessitates the maximum exploitation of the cover afforded by darkness, making the ability to operate effectively at night a key factor in winning any major conflict. Unfortunately, the majority of the operational helicopter fleet was designed years ago with mainly daylight operations in mind. Converting these existing cockpits to an appropriate standard of night vision goggle (NVG) compatibility is no simple task. Quick fit, inexpensive fixes are rare and offer only limited value. The United Kingdom's Ministry of Defense (UK MOD) has learned this lesson well in recent years, having made large investments in both money and manpower to achieve an acceptable NVG standard of cockpit compatibility in the Sea King, Wessex, Lynx, Puma, Chinook, Gazelle, Scout and A109 helicopters. This paper will present an overview of helicopter NVG compatibility testing in the UK. A synopsis of the principles of image intensification will justify the logic behind various NVG modifications. An historic overview will then set the stage for the NVG cockpit developments, followed by a general discussion of some important compatibility issues. A review of the NVG operational assessments conducted in several different flight environments will conclude this discussion by presenting results peculiar to each environment. These wide-ranging assessments have provided the experience to develop a practical scientific approach to NVG cockpit compatibility testing which is offered in a summary of test methods. Author

N93-19955# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
VENTILATION LOSS IN THE NASA SPACE SHUTTLE CREW PROTECTIVE GARMENTS: POTENTIAL FOR HEAT STRESS Final Report
GREGORY K. ASKEW and JONATHAN W. KAUFMAN 31 Dec. 1991 20 p
(AD-A258552; NADC-91129-60) Avail: CASI HC A03/MF A01

The potential of the National Aeronautics and Space Administration (NASA) S1035 Launch/Entry suit (LES) for producing heat stress in a simulated Space Shuttle cabin environment has been studied. The testing was designed to determine if the NASA S1035 poses a greater threat of inducing heat stress than the NASA S1032. Conditions were designed to simulate an extreme prelaunch situation, with chamber temperatures maintained at dry bulb temperature 27.2 +/- 0.1 C, globe temperature - 27.3 +/- 0.1 C, and wet bulb temperature 21.1 +/- 0.3 C. Four males, aged 28-48, were employed in this study, with three subjects having exposures in all four conditions and the fourth subject exposed to 3 conditions. Test durations in the ventilated (V) and unventilated (UV) conditions were designed for 480 minutes, which all subjects achieved. No significant differences related to experimental conditions were noted in rectal temperatures, heart rates or sweat rates. The results indicate that the S1032 and S1035 garments, in either the V or UV state, poses no danger of inducing unacceptable heat stress under the conditions expected within the Shuttle cabin during launch or re-entry. GRA

N93-20050# Dayton Univ., OH. Research Inst.
NIGHT VISION GOGGLE TRAINING: DEVELOPMENT AND PRODUCTION OF SIX VIDEO PROGRAMS Final Report, Jan. - Nov. 1992
DEFOREST Q. JORALMON Nov. 1992 13 p
(Contract F33615-90-C-0005)
(AD-A258529; AL-TR-1992-0136) Avail: CASI HC A03/MF A01

A paper submitted to the 14th Interservice/Industry Training Systems Conference held 25 Nov. 1992 in San Antonio, TX is presented. With the increased use of night vision goggles (NVG) within the US Air Force, Navy, and Marine aviation communities, there is an expanded need for NVG training. The role of NVG training videos within the prototype NVG training course, the content of the presentations, and techniques used in the production of the programs are described. It concludes that video presentations showing examples of NVG imagery can successfully be used to augment NVG training. GRA

N93-20065*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A MEMBRANE-BASED SUBSYSTEM FOR WATER-VAPOR RECOVERY FROM PLANT-GROWTH CHAMBERS
R. J. RAY (Bend Research, Inc., OR.) Sep. 1992 70 p
(Contract NAS2-13345)
(NASA-CR-177602; A-92193; NAS 1.26:177602) Avail: CASI HC A04/MF A01

Bioregenerative systems--life-support systems to regenerate oxygen, food, and water--are the key to establishing man's permanent presence in space. NASA is investigating the use of plant-growth chambers (PGC's) for space missions and for bases on the moon and Mars. PGC's serve several important purposes, including the following: (1) oxygen and food production; (2) carbon-dioxide removal; and (3) water purification and reuse. The key to the successful development of PGC's is a system to recover and reuse the water vapor that is transpired by the leaves of the growing plants. In this program we propose to develop a simple, reliable, membrane-based system that allows the recovery, purification, and reuse of the transpired water vapor through control of temperature and humidity levels in the PGC. This system has characteristics that make it ideally suited to use in space: (1) minimal power requirements; (2) small volume and mass; (3) simplicity; (4) reliability; and (5) versatility. In Phase 1 we will do the following: (1) develop an accurate, predictive model of our temperature- and humidity-control system, based on parametric tests of membrane modules; and (2) use this model to design systems for selected PGC's. In Phase 2, we will seek to design, fabricate, test, and deliver a breadboard unit to NASA for testing on a PGC. Author (revised)

N93-20314*# Research Inst. for Computing and Information Systems, Houston, TX.
MISSION AND SAFETY CRITICAL (MASC): AN EVACS SIMULATION WITH NESTED TRANSACTIONS Interim Report
DAVID AUTY (Softech, Inc., Houston, TX.), COLIN ATKINSON (Houston Univ., Clear Lake, TX.), and CHARLIE RANDALL (GHG Corp., Houston, TX.) Sep. 1992 47 p
(Contract NCC9-16; RICIS PROJ. SE-16)
(NASA-CR-192295; NAS 1.26:192295) Avail: CASI HC A03/MF A01

The Extra-Vehicular Activity Control System (EVACS) Simulation with Nested Transactions, a recent effort of the MISSION Kernel Team, is documented. The EVACS simulation is a simulation of some aspects of the Extra-Vehicular Activity Control System, in particular, just the selection of communication frequencies. The simulation is a tool to explore mission and safety critical (MASC) applications. For the purpose of this effort, its current definition is quite narrow serving only as a starting point for prototyping purposes. (Note that EVACS itself has been supplanted in a larger scenario of a lunar outpost with astronauts and a lunar rover). The frequency selection scenario was modified to embed its processing in nested transactions. Again as a first step, only two aspects of transaction support were implemented in this prototype: architecture and state recovery. Issues of concurrency and distribution are yet to be addressed. Author

N93-20319*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PHYSIOLOGICAL RESPONSES TO WEARING THE SPACE SHUTTLE LAUNCH AND ENTRY SUIT AND THE PROTOTYPE ADVANCED CREW ESCAPE SUIT COMPARED TO THE UNSUITED CONDITION
LINDA H. BARROWS (Krug Life Sciences, Inc., Houston, TX.), JOHN J. MCBRINE (Krug Life Sciences, Inc., Houston, TX.), JUDITH C. HAYES (Krug Life Sciences, Inc., Houston, TX.), MARCELLA D. STRICKLIN (Krug Life Sciences, Inc., Houston, TX.), and MICHAEL C. GREENISEN Washington Mar. 1993 13 p
(NASA-TP-3297; S-694; NAS 1.60:3297) Avail: CASI HC A03/MF A01

The launch and entry suit (LES) is a life support suit worn during Orbiter ascent and descent. The impact of suit weight and restricted mobility on egress from the Orbiter during an emergency is unknown. An alternate suit - the advanced crew escape suite (ACES) - is being evaluated. The physiological responses to ambulatory exercise of six subjects wearing the LES and ACES were measured and compared to those measurements taken while unsuited. Dependent variables included heart rate and metabolic response to treadmill walking at 5.6 km/h (3.5 mph), and also bilateral concentric muscle strength about the knee, shoulder, and elbow. No significant (p greater than 0.06) differences in heart rate or metabolic variables were measured in either suit while walking at 5.6 km/h. Significant (p less than 0.05) decreases in all metabolic variables were remarked when both suits were compared to the unsuited condition. There were no significant (p greater than 0.05) differences among the three suit conditions at 30 or 180 deg/s for muscles about the elbow and knee; however, about the shoulder, a significant ($p = 0.0215$) difference between the ACES and the unsuited condition was noted. Therefore, wearing a life support suit while performing Orbiter egress imposes a significant metabolic demand on crewmembers. Selective upper body strength movements may be compromised. Author

N93-20413# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
STUDY ON ENVIRONMENT CONTROL AND LIFE SUPPORT TECHNOLOGY [KANKYOU SEIGYO/SEIMEI IJI GIJUTSU NO CHOUSA KENTOU]
TSUTOMU IWATA and YUKATA TAKANO *In its* Research and Development Activities of the Tsukuba Space Center p 9-12 Aug. 1992 In JAPANESE
Avail: CASI HC A01/MF A03

Study on Environmental Control and Life Support (ECLS) technology, common and fundamental technology for future manned spacecraft, is conducted to contribute planning research and development programs. Study is focused on a regenerative (air and water regeneration) Environmental Control and Life Support System (ECLSS), one of element technologies for manned platform taken as a reference model for this study. The reason for selecting regenerative ECLS is that the existing non regenerative ECLS is deemed to be disadvantageous in the aspects of transportation costs for logistics and waste, and resource consumption. Taking Manned Platform (MPF) as a reference model, subsystem technologies are studied focusing on following subjects: (1) air regeneration technologies, including carbon dioxide removal, carbon dioxide reduction and oxygen production, and toxic gas removal; and (2) water regeneration technologies.
Author (NASDA)

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A93-21847* National Aeronautics and Space Administration, Washington, DC.
THE LIFE SPAN OF THE BIOSPHERE REVISITED
KEN CALDEIRA and JAMES F. KASTING (Pennsylvania State Univ., University Park) Nature (ISSN 0028-0836) vol. 360, no. 6406 Dec. 24, 1992 p. 721-723. Research supported by NSF and NASA refs
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How much longer the biosphere can survive on earth is reexamined using a more elaborate model than that of Lovelock and Whitfield (1982). The model includes a more accurate treatment of the greenhouse effect of CO2, a biologically mediated weathering parametrization, and the realization that C4 photosynthesis can persist to much lower concentrations of atmospheric CO2. It is found that a C4-plant-based biosphere could survive for at least another 0.9 Gyr to 1.5 Gyr after the present time, depending

respectively on whether CO2 or temperature is the limiting factor. Within an additional 1 Gyr, earth may lose water to space, thereby following the path of Venus. C.D.

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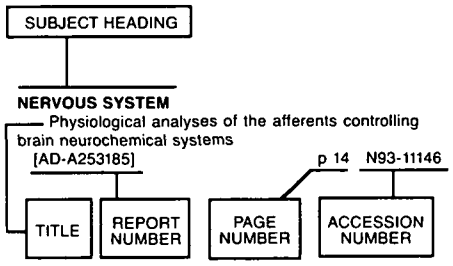

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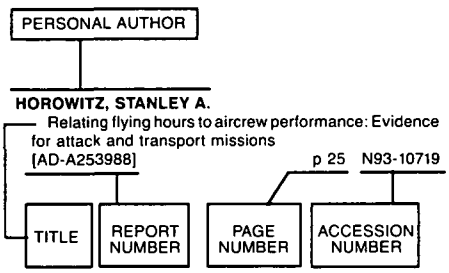

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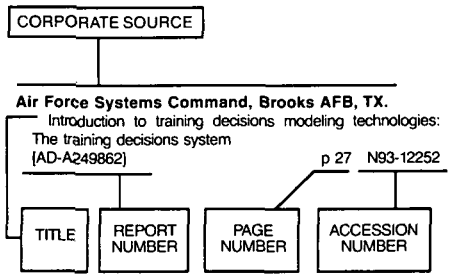

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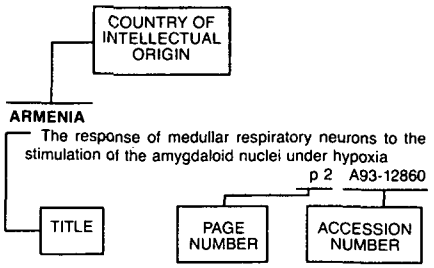

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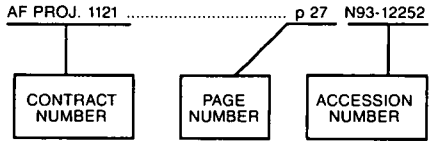

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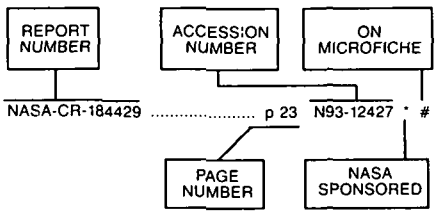

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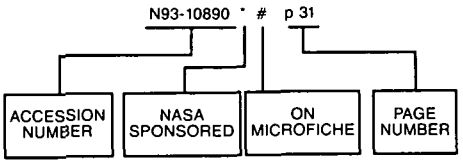

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