NASA SP-7011 (383)
January 1994

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC 1994

This publication was prepared by the NASA Center for AeroSpace Information,
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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 100 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)	None for this issue
International Aerospace Abstracts (IAA) (A-10000 Series)	A93-52651 — A93-56550

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 number, 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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ACCESSION NUMBER → **N93-12195*#** Lockheed Engineering and Sciences, Co., Houston, TX. ← **CORPORATE SOURCE**

TITLE → **ASTRONAUT CANDIDATE STRENGTH MEASUREMENT USING THE CYBEX 2 AND THE LIDO MULTI-JOINT 2 DYNAMOMETERS Final Report**

AUTHORS → AMY E. CARROLL and ROBERT P. WILMINGTON May 1992 ← **PUBLICATION DATE**

CONTRACT NUMBER → (Contract NAS9-17900)

REPORT NUMBERS → (NASA-CR-185679; NAS 1.26:185679; LESC-30277) Avail: CASI ← **AVAILABILITY**

PRICE CODE → HC A03/MF A01

The Anthropometry and Biomechanics Laboratory in the man-Systems division at NASA's Johnson Space Center has as one of its responsibilities the anthropometry and strength measurement data collection of astronaut candidates. The anthropometry data is used to ensure that the astronaut candidates are within the height restrictions for space vehicle and space suit design requirments, for example. The strength data is used to help detect abnormalities or isolate injuries to muscle groups that could jeopardize the astronauts' safety. The Cybex II Dynamometer has been used for strength measurements from 1985 through 1991. The Cybex II was one of the first instruments of its kind to measure strength and similarity of muscle groups by isolating the specific joint of interest. In November 1991, a LIDO Multi-Joint II Dynamometer was purchased to upgrade the strength measurement data collection capability of the Anthropometry and Biomechanics Laboratory. The LIDO Multi-Joint II Dynamometer design offers several advantages over the Cybex II Dynamometer including a more sophisticated method of joint isolation and a more accurate and efficient computer based data collection system. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER → **A93-11150**

TITLE → **STUDIES TOWARDS THE CRYSTALLIZATION OF THE ROD VISUAL PIGMENT RHODOPSIN**

AUTHORS → W. J. DE GRIP, J. VAN OOSTRUM, and G. L. J. DE CALUWE

AUTHORS' AFFILIATION → (Nigmegen Catholic Univ., Netherlands) Journal of Crystal Growth (ISSN 0022-0248) vol. 122, no. 1-4 Aug. 1992 ← **JOURNAL TITLE** ← **PUBLICATION DATE** p. 375-384. Research supported by SRON refs

CONTRACT NUMBER → (Contract NWO-SON-328-050)

Copyright

Results are presented of crystallization experiments on bovine rhodopsin, which established a restricted range of conditions which reproducibly yield rhodopsin crystals. Several parameters were optimized, including the detergent, the precipitant, additives, and pH. The crystals obtained so far are too small (less than 50 microns in any direction) or of insufficient order to allow high-resolution diffraction analysis. Several approaches are proposed for improving the average size, stability, and order of the rhodopsin crystals. I. S.

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 383)

January 1994

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LIFE SCIENCES (GENERAL)

A93-52723
EFFECTS OF CO2 AND PHOTOSYNTHETIC PHOTON FLUX ON YIELD, GAS EXCHANGE AND GROWTH RATE OF LACTUCA SATIVA L. 'WALDMANN'S GREEN'
SHARON L. KNIGHT and CARY A. MITCHELL (Purdue Univ., West Lafayette, IN) Journal of Experimental Botany (ISSN 0022-0957) vol. 39, no. 200 March 1988 p. 317-328. refs
Copyright

Experiments conducted in the framework of NASA's Controlled Ecological Life Support System program aimed at optimization of crop productivity for long-term, manned space habitation are described. Results indicate that leaf lettuce growth is most responsive to a combination of high photosynthetic photon flux and CO2 enrichment to 69 mmol/cu m for several days at the onset of exponential growth, after which optimizing resources might be conserved. AIAA

A93-52878* National Aeronautics and Space Administration, Washington, DC.
UNEXPECTED SUBSTRATE SPECIFICITY OF T4 DNA LIGASE REVEALED BY IN VITRO SELECTION
KAZUO HARADA and LESLIE E. ORGEL (Salk Inst. for Biological Studies, San Diego, CA) Nucleic Acids Research (ISSN 0305-1048) vol. 21, no. 10 1993 p. 2287-2291. refs
(Contract NAGW-2881; NAGW-1600)
Copyright

We have used in vitro selection techniques to characterize DNA sequences that are ligated efficiently by T4 DNA ligase. We find that the ensemble of selected sequences ligates about 50 times as efficiently as the random mixture of sequences used as the input for selection. Surprisingly many of the selected sequences failed to produce a match at or close to the ligation junction. None of the 20 selected oligomers that we sequenced produced a match two bases upstream from the ligation junction.

A93-53284
DEEP-SEA SMOKERS - WINDOWS TO A SUBSURFACE BIOSPHERE?
JODY W. DEMING and JOHN A. BAROSS (Washington Univ., Seattle) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3219-3230. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 Research supported by NSF refs
Copyright

Since the discovery of hyperthermophilic microbial activity in hydrothermal fluids recovered from 'smoker' vents on the East Pacific Rise, the widely accepted upper temperature limit for life (based on pure culture data) has risen from below the boiling point of water at atmospheric pressure to approximately 115 C. Many microbiologists seem willing to speculate that the maximum may be closer to 150 C. We have postulated not only higher temperatures than these (under deep-sea hydrostatic pressures), but also the existence of a biosphere subsurface to accessible sea floor vents. New geochemical information from the Endeavour Segment of the Juan de Fuca Ridge indicative of subsurface organic material caused us to reexamine both the literature on hyperthermophilic microorganisms cultured from deep-sea smoker environments and recent results of microbial sampling efforts at actively discharging smokers on the Endeavour Segment. Here we offer the case for a subsurface biosphere based on an interdisciplinary view of microbial and geochemical analyses of Endeavour smoker fluids, a case in keeping with rapidly evolving geophysical understanding of organic stability under deep-sea hydrothermal conditions. Author (revised)

A93-53285
AQUEOUS HIGH-TEMPERATURE AND HIGH-PRESSURE ORGANIC GEOCHEMISTRY OF HYDROTHERMAL VENT SYSTEMS
BERND R. T. SIMONEIT (Oregon State Univ., Corvallis) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3231-3243. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 refs
(Contract NSF OCE-81-18897; NSF OCE-83-12036; NSF OCE-85-12832; NSF OCE-86-01316; NSF OCE-90-02366)
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A brief review of the fate and chemical alterations of organic matter under hydrothermal conditions is presented. Two major but overlapping aspects, alteration and degradation processes and reactions, both reductive and oxidative, are considered. In the case of hydrothermal systems, organic matter maturation, petroleum generation, expulsion, and migration are compressed into an 'instantaneous' geological time frame. At seafloor spreading axes, hydrothermal systems active under sedimentary cover generate petroleum from generally immature organic matter in the sediments. This hydrothermal petroleum migrates rapidly away from the high-temperature zone, usually upward, and leaves behind a spent carbonaceous residue. Hydrothermal systems operating in unsedimented rift areas generate trace amounts of petroleumlike material. AIAA

A93-53291
HYDROTHERMAL DEHYDRATION OF AQUEOUS ORGANIC COMPOUNDS
EVERETT L. SHOCK (Washington Univ., Saint Louis, MO) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3341-3349. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 refs
(Contract NSF EAR-90-18468)
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Although mineral dehydration in hydrothermal and metamorphic processes is a commonly observed phenomenon, it is often stated that organic compounds will not dehydrate in the presence of an aqueous solution even at elevated temperatures and pressures. Both theoretical calculations and experimental measurements directly refute this paradigm. Results obtained in the present study

indicate that increasing temperature tends to favor dehydration reactions among organic compounds in aqueous solution. Calculation of the thermodynamic properties for several aqueous organic dehydration reactions were conducted using equations, data, and parameters from Shock and Helgeson (1990) and Shock (1992, 1993), together with additional data estimated in this study. Dehydration reactions which may proceed at elevated temperatures include amide formation from carboxylic acids and ammonia, ester formation from carboxylic acids and alcohols, and peptide formation from amino acids. Condensation of complex organic molecules may be energetically favored in hydrothermal solutions, which would greatly facilitate the ability of organisms to infiltrate high-temperature/pressure environments. Author (revised)

A93-53350
LINEAR TETRAPYRROLES (PHYCOBILINS) IN A MODEL PREBIOLOGICAL SYSTEM [LINEJNYE TETRAPIRROLY /FIKOBILINY/ V MODEL'NOJ PREDBIOLOGICHESKOJ SISTEME]
M. P. KOLESNIKOV (RAN, Inst. Biokhimii, Moscow, Russia) Rossijskaya Akademiya Nauk, Izvestiya, Seriya Biologicheskaya (ISSN 0002-3329) no. 3 May-June 1993 p. 357-367. In RUSSIAN refs
Copyright

A model prebiological system was developed in which linear tetrapyrroles act as acceptors of light energy, and transfer the energy to an active flavoproteinoid compound. In this system, flavoproteinoid microspheres and liposomes containing a phycobilin act to sensitize photooxidation of oxalic and glycolic acids and photoreduction of some electron acceptors. They also take part in the reaction of photophosphorylation of ADP to ATP. Arginine-enriched microspheres consume orthophosphate from solution (in light). This model system can be used for studying the transmolecular migration of energy of excitation in simple prebiological reactions with the participation of flavin and linear tetrapyrroles. AIAA

A93-54163
RIBOZYMES - A DISTINCT CLASS OF METALLOENZYMES
ANNA M. PYLE (Columbia Univ., New York) Science (ISSN 0036-8075) vol. 261, no. 5122 Aug. 6, 1993 p. 709-714. refs
Copyright

Ribozymes are an important new class of metalloenzymes that have an unlikely feature: they are made entirely of ribonucleic acid (RNA). Metal ions are essential for efficient chemical catalysis by ribozymes and are often required for the stabilization of ribozyme structure. Most ribozymes catalyze reactions at phosphorus centers through one of two major mechanistic pathways, and reaction has been observed at carbon centers. Creative experiments have revealed the position of metal ions in the active site of two ribozymes. The exploitation of variable metal geometry and reactivity has expanded ribozyme chemistry and has facilitated the application of in vitro selection for the creation of novel ribozymes.

A93-54971
OZONE - A NEW ASPECT OF ITS EFFECT ON MICROORGANISMS [OZON - NOVYJ ASPEKT DEJSTVIYA NA MIKROORGANIZMY]
D. N. OSTROVSKIJ, M. A. MARTYNOVA, V. K. MATUS, O. D. OGREL', E. I. LYSAK, E. F. KHARAT'YAN, L. A. SIBEL'DINA, and I. N. SHCHIPANOVA (RAN, Inst. Biokhimii, Moscow, Russia; ANB, Inst. Fotobiologii, Minsk, Byelarus) Rossijskaya Akademiya Nauk, Doklady (ISSN 0869-5652) vol. 331, no. 1 July 1993 p. 104-108. In RUSSIAN Research supported by Rossijskij Fond Fundamental'nykh Issledovanij refs
Copyright

The effect of ozone on microorganisms was investigated experimentally using EPR and NMR spectrometry. The microorganisms used in the study included Brevibacterium ammoniagenes, Micrococcus luteus, and Mycobacterium smegmatis. The most important results of the study is evidence of oxidative activation by ozone of the ferments of new cyclopyrophosphate synthesis. The membrane permeability barrier is largely retained despite significant changes in the membrane lipids. AIAA

A93-55168* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A SIMPLE HINDLIMB SUSPENSION APPARATUS
E. PARK and E. SCHULTZ (Wisconsin Univ., Madison) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 401-404. refs
(Contract NAG2-671)
Copyright

This paper describes the assembly of a simple, inexpensive apparatus for application of the hindlimb suspension model to studies of the effects of unloading on mammalian physiology. Construction of a cage and suspension assembly is described using materials that can be obtained from most hardware stores. The design is kept simple for easy assembly and disassembly to facilitate cleaning and storage. The suspension assembly allows the animals full access to all portions of the floor area and provides an effective environment to study the effects of unloading.

A93-55292
GROUP II INTRON RNA CATALYSIS OF PROGRESSIVE NUCLEOTIDE INSERTION - A MODEL FOR RNA EDITING
MANFRED W. MUELLER, MARTIN HETZER, and RUDOLF J. SCHWEYEN (Vienna Univ., Austria) Science (ISSN 0036-8075) vol. 261, no. 5124 Aug. 20, 1993 p. 1035-1038. Research supported by BMFWF and FFWF refs
Copyright

The self-splicing bl1 intron lariat from mitochondria of Saccharomyces cerevisiae catalyzed the insertion of nucleotidyl monomers derived from the 3' end of a donor RNA into an acceptor RNA in a 3' to 5' direction in vitro. In this catalyzed reaction, the site specificity provided by intermolecular base pair interactions, the formation of chimeric intermediates, the polarity of the nucleotidyl insertion, and its reversibility all resemble such properties in previously proposed models of RNA editing in kinetoplastid mitochondria. These results suggest that RNA editing occurs by way of a concerted, two-step transesterification mechanism and that RNA splicing and RNA editing might be prebiotically related mechanisms; possibly, both evolved from a primordial demand for self-replication.

A93-55329
SHORTENING VELOCITY AND CALCIUM SENSITIVITY OF SINGLE FIBERS FROM HINDLIMB SUSPENDED MUSCLE IN RATS
KATSUMASA YAMASHITA and TOSHITADA YOSHIOKA (St. Marianna Univ., Kawasaki, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723) vol. 30, no. 2 June 1993 p. 71-80. In JAPANESE refs
Copyright

We examined the effect of suspension hypokinesia on the maximal shortening velocity (Vmax) and the calcium (Ca(2+)) sensitivity (pCa50) of slow and fast skinned muscle fibers in rats after 2-week tail suspension and two-week tail suspension and two-week recovery. Maximal tension in the fiber dissected from extensor digitorum longus (EDL) muscle was significantly lower, but that in the fiber dissected from soleus muscle not different from the cage control. The Vmax in soleus and EDL and pCa50 in EDL increased following suspension. The maximal tension in EDL, Vmax, and pCa50 in soleus and EDL were normalized after two weeks of recovery. The results demonstrate that the rate constant of cross-bridge cycle is altered during hypokinesia and the altered muscle function during hypokinesia recovered to the control level when the rats were released from suspension for the same period as tail suspension. Author (revised)

A93-55458* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EFFECT OF INSULIN-LIKE FACTORS ON GLUCOSE TRANSPORT ACTIVITY IN UNWEIGHTED RAT SKELETAL MUSCLE
ERIK J. HENRIKSEN and LESLIE S. RITTER (Arizona Univ., Tucson) Journal of Applied Physiology (ISSN 8750-7587) vol. 75, no. 2 Aug. 1993 p. 820-824. Research supported by Univ. of Arizona Heart Run Fund refs
(Contract NAG2-782; NIH-S07-RR-07002)

The effect of 3 or 6 days of unweighting on glucose transport activity, as assessed by 2-deoxyglucose uptake, in soleus strips stimulated by maximally effective concentrations of insulin, IGF-I, vanadate, or phospholipase C (PLC) is examined. Progressively increased responses to maximally effective doses of insulin or insulin-like growth factor were observed after 3 and 6 days of unweighting compared with weight matched control strips. Enhanced maximal responses to vanadate (6 days only) and PLC (3 and 6 days) were also observed. The data provide support for the existance of postreceptor binding mechanisms for the increased action of insulin on the glucose transport system in unweighted rat skeletal muscle. AIAA

A93-55580
DNA TOPOISOMERASE V IS A RELATIVE OF EUKARYOTIC TOPOISOMERASE I FROM A HYPERTHERMOPHILIC PROKARYOTE
ALEKSEI I. SLESAREV (California Univ., Los Angeles; Russian Academy of Sciences, Inst. of Molecular Genetics, Moscow, Russia), KARL O. STETTER (Regensburg Univ., Germany), JAMES A. LAKE (California Univ., Los Angeles), MARTIN GELLERT, REGIS KRAH (NIH, National Inst. of Diabetes and Digestive and Kidney Diseases, Bethesda, MD), and SERGEJ A. KOZYAVKIN (Ukrainian Academy of Sciences, Inst. of Oncology and Radiobiology, Kiev, Ukraine; NIH, National Inst. of Diabetes and Digestive and Kidney Diseases, Bethesda, MD) Nature (ISSN 0028-0836) vol. 364, no. 6439 Aug. 19, 1993 p. 735-737. Research supported by NSF, Alexander von Humboldt Foundation, Alfred P. Sloan Foundation, et al refs

A prokaryotic counterpart of the eukaryotic topoisomerase I in the hyperthermophilic methanogen Methanopyrus kandleri is characterized. The new enzime, topoisomerase V, has properties in common with eukaryotic topoisimerase I, which distinguish it from all other known prokaryotic topoisomerases. Its activity is Mg(2+)-independent; it relaxes both negatively and positively supercoiled DNA; it makes a covalent complex with the 3' end of the broken strand; and it is recognized by antibody raised against human topoisomerase I. The findings support the idea that some essential parts of the eukaryotic transcription-translation and replication machineries were in place before the emergence of eukaryotes, and that the closest living relatives of eukaryotes may by hyperthermophiles. AIAA

A93-55930
MOTION SICKNESS AND EVOLUTION
KENNETH E. MONEY (DND, Defence and Civil Inst. of Environmental Medicine, Ottawa, Canada) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 1-7. refs

Development of physiological mechanisms of motion sickness during evolution is reviewed. Available evidence indicates that motion sickness is caused by activation of a vestibular mechanisms by motions that normally functions in the response to poisons. The unnatural motions probably produce a central vestibular dysfunction similar to that produced by certain poisons. AIAA

A93-55931
THE CENTRAL NERVOUS CONNECTIONS INVOLVED IN MOTION INDUCED EMESIS
KENNETH R. BRIZZEE (Delta Regional Primate Research Center, Covington, LA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 9-27. refs

Available information on the pathways through which motion sickness generating impulses are conducted to the final common pathway involved in eliciting an emetic reaction is reviewed. Topics addressed include vestibular receptors, primary sensory neurons and afferent vestibular fibers, secondary vestibular afferent fibers, afferent vestibular fibers, vomiting center, afferent input to PCRF, and area postrema, nucleus of the solitary tract, and vagal nuclear complex. AIAA

A93-55932
NEUROPHYSIOLOGY OF MOTION SICKNESS
GEORGE H. CRAMPTON (Wright State Univ., Dayton, OH) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 29-42. refs

Neurophysiological data on motion sickness is reviewed in the framework of the sensory rearrangement theory. The labyrinth, cerebellum, and vomiting center are identified as the only necessary components for motion sickness. Simple linear combinations of sensory data are processed within the vestibular nuclei, whereas the primary and more complex comparator or neural store is found within the cerebellum, in which modification of the neural store during exposure to conflicting or new spatial circumstances takes place. A second comparator is located within the forebrain and subserves more complex inertial frame of reference functions. AIAA

A93-55933 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ROLE OF THE VESTIBULAR END ORGANS IN EXPERIMENTAL MOTION SICKNESS - A PRIMATE MODEL
MAKOTO IGARASHI (Baylor College of Medicine, Houston, TX) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 43-48. refs
(Contract NAG2-289; NAS9-14546)

Experimental studies of the role of vestibular end organs in motion sickness experienced by squirrel monkeys are reviewed. The first experiments in motion-sickness-susceptible squirrel monkeys were performed under a free-moving condition with horizontal rotation and vertical oscillation. In the following experiments, the vestibular-visual conflict in the pitch plane was given to the chair-restrained (upright position) squirrel monkeys. Results of this study showed that the existence of otolith afferents, which continually signal the directional change of gravity and linear acceleration vectors, was necessary for the elicitation of emesis by the sensory conflict in pitch. AIAA

A93-55934
NEUROCHEMISTRY AND PHARMACOLOGY OF MOTION SICKNESS IN NONHUMAN SPECIES
JAMES B. LUCOT (Wright State Univ., Dayton, OH) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 49-63. refs

Animals were used as subjects in experiments designed to study the role of neurotransmitters, neuromodulators, hormone systems, and receptor binding. It is concluded that the original animal research failed to find anti-motion sickness effects for scopolamine. It also had false positives and possible false negatives. The value of animal tests was demonstrated by the positive results obtained with sulpiride and the serotonin-1A agonists. The studies used either drugs or doses of drugs not approved for use in humans. The range of experimental animal studies is essential for understanding the underlying processes and developing new therapeutic measures. AIAA

A93-55936* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANIMAL MODELS IN MOTION SICKNESS RESEARCH

NANCY G. DAUNTON (NASA, Ames Research Center, Moffett Field, CA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 87-104. refs
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Practical information on candidate animal models for motion sickness research and on methods used to elicit and detect motion sickness in these models is provided. Four good potential models for use in motion sickness experiments include the dog, cat, squirrel monkey, and rat. It is concluded that the appropriate use of the animal models, combined with exploitation of state-of-the-art biomedical techniques, should generate a great step forward in the understanding of motion sickness mechanisms and in the development of efficient and effective approaches to its prevention and treatment in humans. AIAA

A93-55937* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INVESTIGATING MOTION SICKNESS USING THE CONDITIONED TASTE AVERSION PARADIGM
ROBERT A. FOX (San Jose State Univ., CA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 105-121. refs
(Contract NCC2-167)
Copyright

The use of conditioned taste aversion (CTA) to study motion sickness is reviewed. The use of CTA to measure motion sickness is supported by studies showing that an intact vestibular system is essential for the production of CTA when motion is the unconditioned stimulus. The magnitude of CTA is assessed at a time removed from exposure to motion, and therefore is not affected by residual effects of motion. Since the magnitude of CTA is assessed as volume or weight of flood or fluid, the degree of sickness is reflected in a continuous measure rather than in the discrete, all-or-none fashion characteristic of vomiting. AIAA

A93-55999
CHLOROFLEXUS AURANTIACUS AND ULTRAVIOLET RADIATION - IMPLICATIONS FOR ARCHEAN SHALLOW-WATER STROMATOLITES
BEVERLY K. PIERSON, HEATHER K. MITCHELL, and ALYSON L. RUFF-ROBERTS (Univ. of Puget Sound, Tacoma, WA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 4 Aug. 1993 p. 243-260. Research supported by Univ. of Puget Sound refs
(Contract NSF BSR-88-18133)
Copyright

The phototrophic growth of Chloroflexus aurantiacus under anoxic conditions was determined as a function of continuous UV irradiance. Cultures grown under an irradiance of 0.01 W/sq m exhibited a slightly depressed yield over the non-irradiated control. Yields decreased further with increasing irradiance. Inhibition was severe at an irradiance of 0.66 W/sq m. Growth of E. coli cultures was severely depressed at UV-C irradiances that permitted good growth of C aurantiacus. Low levels of Fe(3+) provided a very effective UV absorbing screen. The apparent UV resistance of Chloroflexus and the effectiveness of iron as a UV-absorbing screen in sediments and microbial mats are suggested to be likely mechanisms of survival of early phototrophs in the Precambrian in the absence of an ozone shield. Author (revised)

A93-56548* National Aeronautics and Space Administration, Washington, DC.
ISOLATION OF NEW RIBOZYMES FROM A LARGE POOL OF RANDOM SEQUENCES
DAVID P. BARTEL and JACK W. SZOSTAK (Massachusetts General Hospital, Boston) Science (ISSN 0036-8075) vol. 261, no. 5127 Sept. 10, 1993 p. 1411-1418. Research supported by Hoechst AG and NASA refs
Copyright

An iterative in vitro selection procedure was used to isolate a new class of catalytic RNAs (ribozymes) from a large pool of random-sequence RNA molecules. These ribozymes ligate two RNA molecules that are aligned on a template by catalyzing the attack of a 3'-hydroxyl on an adjacent 5'-triphosphate - a reaction similar to that employed by the familiar protein enzymes that synthesize RNA. The corresponding uncatalyzed reaction also yields a 3',5'-phosphodiester bond. In vitro evolution of the population of new ribozymes led to improvement of the average ligation activity and the emergence of ribozymes with reaction rates 7 million times faster than the uncatalyzed reaction rate. Author (revised)

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AEROSPACE MEDICINE

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

A93-52692#
THE LIMITS OF HUMAN IMPACT ACCELERATION TOLERANCE
G. P. STUPAKOV and YU. V. MAZURIN (Russian Air Force Inst. of Aerospace Medicine, Moscow, Russia) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 324-327. refs
(AIAA PAPER 93-3572) Copyright

The experimental and theoretical basis for developing new criteria of trauma safety and the effect of impact-acceleration exposure subjectively estimated by human subjects. Particular attention is given to the five factors related to the occurrence of traumatic lesions in pilots flying aircraft equipped with ejection seats. AIAA

A93-53025* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DESIGN OF A READING TEST FOR LOW VISION IMAGE WARPING
DAVID S. LOSHIN, JANICE WENSVEEN (Houston Univ., TX), RICHARD D. JUDAY, and R. S. BARTON (NASA, Johnson Space Center, Houston, TX) *In* Visual information processing II; Proceedings of the Meeting, Orlando, FL, Apr. 14-16, 1993 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1993 p. 67-72. Research supported by NASA refs
Copyright

NASA and the University of Houston College of Optometry are examining the efficacy of image warping as a possible prosthesis for at least two forms of low vision - maculopathy and retinitis pigmentosa. Before incurring the expense of reducing the concept to practice, one would wish to have confidence that a worthwhile improvement in visual function would result. NASA's Programmable Remapper (PR) can warp an input image onto arbitrary geometric coordinate systems at full video rate, and it has recently been upgraded to accept computer-generated video text. We have integrated the Remapper with an SRI eye tracker to simulate visual malfunction in normal observers. A reading performance test has been developed to determine if the proposed warpings yield an increase in visual function; i.e., reading speed. We will describe the preliminary experimental results of this reading test with a simulated central field defect with and without remapped images.

A93-54306* National Aeronautics and Space Administration, Washington, DC.
MEETING HUMAN NEEDS
ARNAULD E. NICOGOSSIAN (NASA, Life Sciences Div., Washington) *In* Humans and machines in space: The vision, the challenge, the payoff; Proceedings of the 29th Goddard Memorial Symposium, Washington, Mar. 14, 15, 1991 San Diego, CA Univelt, Inc. 1992 p. 61-72. refs
(AAS PAPER 91-313) Copyright

The degree of autonomy of future long duration manned

missions will emphasize interactions between human operators and automated systems aimed at the most effective allocations of tasks between humans and machines. Knowledge of crewmembers' physical status, encompassing both capabilities and limitations, will also be critical during EVA and planetary roving missions; psychological evaluation and support, with a view to both individual health and group cohesion and productivity, may become a critical consideration. Attention is here given to crewmembers' medical and psychological vulnerabilities. AIAA

A93-54309
REMOTE MEDICAL SYSTEMS FOR THE HUMAN EXPLORATION OF SPACE
HARRY C. HOLLOWAY (Uniformed Services Univ. of the Health Sciences, Bethesda, MD) *In* Humans and machines in space: The vision, the challenge, the payoff; Proceedings of the 29th Goddard Memorial Symposium, Washington, Mar. 14, 15, 1991 San Diego, CA Univelt, Inc. 1992 p. 87-92.
(AAS PAPER 91-321) Copyright

An account is given of design criteria guiding the character of the medical care system that must address the unique requirements of long-term exploratory space missions. Preventive care will in this system be at a premium, and must very directly engage the spacecraft life support system. It is noted that planning for long-term space travel assumes that medical risks can be specifically anticipated, so that an acceptable level of risk reduction can be achieved. All medical techniques employed must be demonstrated in micro-G environments before being contemplated for this application. AIAA

A93-55162* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
PHENYTOIN AS A COUNTERMEASURE FOR MOTION SICKNESS IN NASA MARITIME OPERATIONS
DANIEL WOODARD, GLENN KNOX, K. J. MYERS, WILLIAM CHELEN, and BECKI FERGUSON (NASA, Kennedy Space Center, Cocoa Beach; Florida Univ., Jacksonville) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 363-366. Research supported by Thiokol Corp refs
Copyright

Seasickness is the most prevalent form of motion sickness and is an operational problem during Space Shuttle Solid-fueled Rocket Booster (SRB) retrieval. Phenytoin has been shown to protect against motion sickness induced by Coriolis stress. We exposed SRB recovery personnel to off-vertical rotation and sea motion after phenytoin or placebo. Phenytoin blood levels of at least 9 micrograms/ml were protective against motion sickness at sea. No change in susceptibility to nitrogen narcosis was seen in divers in chamber tests at 460 KPa. Phenytoin was used during the performance of critical and hazardous tasks during training and actual SRB recovery operations. Phenytoin is an effective operational countermeasure for motion sickness for selected SRB crew members. Author (revised)

A93-55163
EVALUATION OF ZOLPIDEM ON ALERTNESS AND PSYCHOMOTOR ABILITIES AMONG AVIATION GROUND PERSONNEL AND PILOTS
BRUNO A. SICARD (Service de Sante, Base Aeronavale, Rochefort, France), S. TROCHERIE (CEA, CRSSA, Fontenay-aux-Roses, France), J. MOREAU (Synthelabo France, Le Plessis-Robinson), H. VIEILLEFOND (Centre d'Essais en Vol, Bretigny-sur-Orge, France), and L. A. COURT (CEA, CRSSA, Fontenay-aux-Roses, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 371-375. refs
Copyright

The use of hypnotics to optimize rest periods during sustained operations could be of help to military personnel. Zolpidem, an imidazopyridine hypnotic, was evaluated for its residual effects on daytime wakefulness in 12 subjects belonging to ground air force personnel and 12 navy fighter pilots. In this controlled double blind crossover study, each subject randomly received zolpidem 10 mg, flunitrazepam 1 mg or placebo, in three separate sessions, 1 week apart at 10 p.m. or 1 a.m., respectively. The absence of residual effects after zolpidem intake was attested by subjective assessments, psychomotor tests (including a simulated flight), and EEG analysis showed that this hypnotic could be considered for operational use.

A93-55165
HIGHER CAPILLARY FILTRATION RATE IN THE CALVES OF ENDURANCE-TRAINED SUBJECTS DURING ORTHOSTATIC STRESS
WULF HILDEBRANDT, HARALD SCHUETZE, and JUERGEN STEGEMANN (Deutsche Sporthochschule, Cologne, Germany) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 380-385. refs
(Contract DARA-FKZ-01-QV-8735)
Copyright

The effect of endurance training on the rate of transcapillary filtration during orthostasis was studied in the human calf. Two groups of sports students with markedly different aerobic capacities performed an orthostatic tilt table test (25 min supine, 10 min upright, 10 min supine). The following parameters were measured: heart rate, brachial and peripheral blood pressure, calf volume changes (impedance), and calf blood flow (venous occlusion technique). The two groups did not differ in maximal calf circumference, body height, or weight. No syncope occurred, and heart rate and blood pressure responses to upright tilt were similar in both groups. However, the capillary filtration rate revealed much higher values in the trained group: 0.086 vs. 0.036 ml/min 100 ml. The estimated additional fluid accumulation in the interstitial space in trained subjects may be as high as 260 ml within the first 20 rain of orthostasis and may play a role in often reported late syncopes, depending on the preexisting fluid state.
Author (revised)

A93-55167
PERFUSION OF THE VISUAL CORTEX DURING PRESSURE BREATHING AT DIFFERENT HIGH-G STRESS PROFILES
PHILIP C. NJEMANZE (Chidicon Medical Centre, Owerri, Nigeria; Chidicon, Inc., Valley Park, MO), PAUL J. ANTOL (McDonnell Douglas Corp., Saint Louis, MO), and CLAES E. G. LUNDGREN (New York State Univ., Buffalo) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 396-400. Research supported by Chidicon, Inc. and McDonnell Douglas Corp refs
Copyright

The effects of pressure breathing for G protection (PBG) on perfusion of the visual cortex were studied in a subject during various high-G stress profiles. Blood flow velocity was measured in the posterior cerebral artery using a transcranial Doppler (TCD) ultrasound instrument. The G profiles examined included gradual and rapid onset rates. Mean cerebral blood flow velocity (MCBFV) declined with increasing +Gz with G-suit protection alone. The MCBFV increased in direct proportion with increase in +Gz acceleration with PBG. The mediating mechanisms for the effects of PBG may include improved gaseous exchange, the diminished sympathicoadrenal discharges, and cardiopulmonary reflexes. A role for TCD in further research is indicated.

A93-55169
PHOTO-REFRACTIVE KERATECTOMY (PRK) - THREAT OR MILLENNIUM FOR MILITARY PILOTS?
ANDREW S. MARKOVITS (U.S. Navy, Naval Aerospace Medical Inst., Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 409-411.
Copyright

The development of the excimer laser, which is capable of correcting myopia without leaving obvious scars as does radial keratotomy, makes it certain that this promising but very new modality is something the military aviation community will be facing in the immediate future. Methods of detection are available, but are expensive and time-consuming. Should military aviation permit

or even sponsor a group of PRK student pilots in order to observe them closely, and then perhaps use this new modality in place of contact lenses or even spectacles?

A93-55328
EFFECT OF WATER IMMERSION ON MUSCLE SYMPATHETIC NERVE RESPONSE DURING STATIC MUSCLE CONTRACTION
MITSURU SAITO, TADAAKI MANO, SATOSHI IWASE, KAZUO KOGA, CHIHIRO MIWA, and KINSAKU INAMURA (Toyota Technological Inst.; Nagoya Univ., Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723) vol. 30, no. 2 June 1993 p. 63-69. In JAPANESE refs
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The effect of microgravity on sympathetic nerve response to muscular exercise was investigated in a human subject, by measuring muscle sympathetic nerve activity (MSA) of the tibial or peroneal nerve recorded micrographically during static hand-grip exercise of a subject under microgravity, simulated by water immersion (WET), and during normal, dry condition (DRY). The results show that the MSA responsiveness to static muscle contraction is not altered under simulated weightlessness, but that the level of MSA is significantly suppressed both at resting condition and during muscular contraction. The strong suppression of sympathetic outflow to the skeletal muscle under microgravity is considered to be related to reduced adaptation of skeletal muscle function and the mechanism of muscular atrophy under microgravity. AIAA

A93-55332
HYPOBARIC HYPOXIA AS A CORRECTION AND REHABILITATION METHOD IN AVIATION MEDICINE [*GIPOBARICHESKAYA GIPOKSIYA KAK METOD KORREKTSII I REABILITATSII V AVIATSIONNOJ MEDITSINE*]
V. S. NOVIKOV, S. I. LUSTIN, and V. V. GORANCHUK Voenno-Meditsinskij Zhurnal (ISSN 0026-9050) no. 5 May 1993 p. 45-47. In RUSSIAN refs
Copyright

The effectiveness of hypobaric hypoxia (HBH) treatments (five to fifteen simulated daily 'ascents' in a pressure chamber to an altitude of 3500 m) as a method for correcting psychological and physiological fatigue in pilots completing prolonged and/or stressful missions was investigated in three groups of pilots: (1) fatigued subjects with diagnosed conditions near pathological ones and with lowered work capacity, (2) subjects with low vestibular stability, and (3) pilots undergoing a 10-day-long rest after prolonged and stressful activity. Results of measurements of immunological and psychophysiological indices showed that five HBH daily treatments were enough to cause a significant improvement in the subjects' work capacity and some of the psychophysiological indices. Fifteen HBH treatments were effective in restoring normal activity of the vegetative nervous system, activating the immunological defense, and increasing the oxygen budget. AIAA

A93-55333
DYNAMICS OF ELECTROENCEPHALOGRAPHIC INDICES DURING ACUTE HYPOXIA [DINAMIKA POKAZATELEJ EHLEKTROEHNTSEFALOGRAMMY U LETCHIKOV PRI OSTROJ GIPOKSII]
YU. A. SHPATENKO, V. V. MORGUN, A. N. LEBEDEV, V. K. STEPANOV, I. K. SHEKHOVTSEV, V. M. NALIZHITYJ, and M. V. DVORNIKOV Voenno-Meditsinskij Zhurnal (ISSN 0026-9050) no. 5 May 1993 p. 48-50. In RUSSIAN refs
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The effect of acute hypoxia on the dynamics of EEG indices was investigated in healthy experienced pilots. It was found that, following the initial inhalation step, the EEG parameters of the alpha-rhythm had three phases. First, there was an increase of the dominant frequency, while the level of the subjects' sensation of well-being remained satisfactory (the compensation phase). The compensation phase was followed by a slowdown of the dominant frequency and a lowering of the oscillation amplitude, marking the beginning of the breakdown of the adaptation mechanisms; this phase coincided with lowering of the subjective feeling of well-being and the work capacity, and a deterioration of psychopathological indices. The third phase was characterized by the restoration of the alpha-rhythm frequency and by the improvement of the sensation of well-being. AIAA

A93-55457
CENTRAL CARDIOVASCULAR PRESSURES DURING GRADED WATER IMMERSION IN HUMANS
ANDERS GABRIELSEN, LARS B. JOHANSEN, and PETER NORSK (Danish Aerospace Medical Centre of Research; Rigshospitalet, Copenhagen, Denmark) Journal of Applied Physiology (ISSN 8750-7587) vol. 75, no. 2 Aug. 1993 p. 581-585. Research supported by Danish Space Board refs
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Arterial blood pressures, including systolic, diastolic, mean, and pulse, heart rate, central venous pressure (CVP), and transmural CVP, were simultaneously measured during a graded water immersion protocol in humans. It is concluded that water immersion in humans induces an increase in cardiac filling pressures with an increase in pulse pressure and a consequent decrease in heart rate. Changes in CVP accurately reflect changes in cardiac distension during water immersion. AIAA

A93-55802
REVIEW OF THE SPACE MEDICO-ENGINEERING RESEARCH IN CHINA
DAQING XIE (Inst. of Space Medico-Engineering, Beijing, China) *In* International Space Year in the Pacific basin; Proceedings of the 4th International Space Conference of Pacific-basin Societies, Kyoto, Japan, Nov. 17-20, 1991 San Diego, CA Univelt, Inc. 1992 p. 97-102. refs
(AAS PAPER 91-623) Copyright

Space medical-engineering research in China is reviewed, with particular reference to the work of the Institute of Space Medical Engineering (ISME). Research in the areas of man-machine-environment system engineering, cardiovascular function, and space motion sickness is briefly summarized. AIAA

A93-55805* National Aeronautics and Space Administration, Washington, DC.
NASA'S MANNED SPACE FLIGHT PROGRAM
ARNAULD E. NICOGOSSIAN (NASA, Life Sciences Div., Washington), RONALD C. TEETER, and KAREN K. GAISER (Lockheed Engineering & Sciences Co., Washington) *In* International Space Year in the Pacific basin; Proceedings of the 4th International Space Conference of Pacific-basin Societies, Kyoto, Japan, Nov. 17-20, 1991 San Diego, CA Univelt, Inc. 1992 p. 123-148. refs
(AAS PAPER 91-626) Copyright

The NASA manned space flight program from Project Mercury onward is reviewed. Particular attention is given to the Gemini missions, Apollo, Skylab, and the Space Shuttle. Aspects of medical care and health maintenance in the U.S. space program are treated in some detail. Consideration is also given to opportunities connected with Space Station Freedom, issues for human exploration of the solar system, and international cooperation in the space life sciences. AIAA

A93-55929
MOTION AND SPACE SICKNESS
GEORGE H. CRAMPTON, ED. (Wright State Univ., Dayton, OH) Boca Raton, FL CRC Press, Inc. 1990 459 p. For individual items see A93-55930 to A93-55949
(ISBN 0-8493-4703-3) Copyright

A collection of papers that address the major issues of motion and space sickness is presented. Attention is given to motion sickness and evolution, the central nervous connections involved in motion induced emesis, neurophysiology of motion sickness, the role of vestibular end organs in experimental motion sickness, neurochemistry and pharmacology of motion sickness in nonhuman species, endocrinology of space/motion sickness, animal models in motion sickness research, investigating motion sickness using the conditioned taste aversion paradigm, the accelerative stimulus

for motion sickness, and physiology of motion sickness symptoms. Also discussed are prediction of motion sickness susceptibility, symptoms and signs of space motion sickness on Spacelab-1, adaptation of the stimulated stimulus rearrangement of weightlessness, statistical prediction of space motion sickness, simulator sickness, pharmacological countermeasures against motion sickness, autogenic feedback training as a treatment for motion and space sickness, adaptation to nauseogenic motion stimuli and its application in the treatment of airsickness, motion sickness susceptibility and behavior, and motion sickness and human performance. AIAA

A93-55935
ENDOCRINOLOGY OF SPACE/MOTION SICKNESS
RANDALL L. KOHL (Universities Space Research Association, Houston, TX) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 65-86. refs
Copyright
Studies aimed at defining the endocrinology of space/motion sickness (SMS) are reviewed. Particular attention is given to endocrine responses in SMS using in-flight, postflight, and terrestrial data, pharmacological manipulation of endocrine function and its impact on susceptibility to motion, effects of antimotion sickness drugs on endocrine function, endocrine theories of SMS, and hypothalamic integration of autonomic and endocrine systems and a central role for the paraventricular nucleus. AIAA

A93-55939* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PHYSIOLOGY OF MOTION SICKNESS SYMPTOMS
DEBORAH L. HARM (NASA, Johnson Space Center, Houston, TX) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 153-177. refs
Copyright
Motion sickness research is reviewed with the emphasis placed on theories developed to explain its symptomatology. A general review of central nervous system, autonomic nervous system, and neuroendocrine system involvement in the syndrome. Particular attention is given to signs, symptoms, and physiological correlates, methodological issues, and directions for future research based on a dynamic interactive systems model. AIAA

A93-55940
PREDICTION OF MOTION SICKNESS SUSCEPTIBILITY
ROBERT S. KENNEDY (Essex Corp., Orlando, FL), WILLIAM P. DUNLAP (Tulane Univ., New Orleans, LA), and JENNIFER E. FOWLKES (Essex Corp., Orlando, FL) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 179-215. Research supported by DOD, DOE, U.S. Navy, et al refs
Copyright
The prediction of susceptibility based on stable and enduring characteristics of the individual is addressed. Topics discussed include a taxonomy of predictors, physiological and psychological predisposition, plasticity measures, provocative tests, and operational environments. The most relevant information for evaluating the strength of a predictor, i.e., the size of the obtained relationship and its statistical likelihood, the size and characteristics of the sample, and the reliability of the measures, is presented. AIAA

A93-55941* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE MOTION SICKNESS MONITORING EXPERIMENT - SPACELAB 1
CHARLES M. OMAN (MIT, Cambridge, MA), BYRON K. LICHTENBERG (Payload Systems, Inc., Cambridge, MA), and KENNETH E. MONEY (DND, Defence and Civil Inst. of Environmental Medicine, Ottawa, Canada) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 217-246. refs
(Contract NAS9-15343)
Copyright
A detailed firsthand report on symptoms and signs of space motion sickness and fluid shift observed by four specially trained crewmembers during Shuttle/Spacelab 1, launched on November 28, 1983 is presented. Results show that three crewmen experienced persistent overall discomfort and vomited repeatedly. Symptom pattern was generally similar to that seen in the individuals preflight, except that prodromalnausea was brief or absent in some cases. Symptoms were clearly modulated by head movement, were exacerbated by unfamiliar visual cues, and could be reduced by physical restraint providing contact cues around the body. The results support the view that space sickness is a form of motion sickness. AIAA

A93-55942
ADAPTATION TO THE SIMULATED STIMULUS REARRANGEMENT OF WEIGHTLESSNESS
DONALD E. PARKER (Miami Univ., Oxford, OH) and KATHERINE L. PARKER (Brigham and Women's Hospital, Boston, MA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 247-262. refs
Copyright
Adaptation, stimulus rearrangements, and responses to these rearrangements are described, and data obtained are applied to promoting adaptation to the stimulus rearrangement of weightlessness and alleviating space motion sickness. Preflight adaptation training aimed at demonstrating the sensory phenomena likely to be experienced in microgravity enables astronauts to train in altered sensory environments, modify the sensory-motor reflexes of the astronauts, and reduce/eliminate space motion sickness symptoms. It is concluded that the overall goals of the preflight adaptation training effort include improvement of astronaut performance and comfort during the initial days of orbital flight and decrement of the potential hazards associated with space motion sickness. AIAA

A93-55943* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
STATISTICAL PREDICTION OF SPACE MOTION SICKNESS
MILLARD F. RESCHKE (NASA, Johnson Space Center, Houston, TX) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 263-316. refs
Copyright
Studies designed to empirically examine the etiology of motion sickness to develop a foundation for enhancing its prediction are discussed. Topics addressed include early attempts to predict space motion sickness, multiple test data base that uses provocative and vestibular function tests, and data base subjects; reliability of provocative tests of motion sickness susceptibility; prediction of space motion sickness using linear discriminate analysis; and prediction of space motion sickness susceptibility using the logistic model. AIAA

A93-55944
SIMULATOR SICKNESS
ROBERT S. KENNEDY, LAWRENCE J. HETTINGER (Essex Corp., Orlando, FL), and MICHAEL G. LILIENTHAL (U.S. Navy, Naval Training Systems Center, Orlando, FL) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 317-341. Research supported by DOD, DOE, U.S. Navy, and Martin Marietta Energy Systems, Inc refs
Copyright
The simulator sickness literature is reviewed focusing on early documentation of incidence and symptomatology, including empirical findings from recent survey work; potential causal factors; models of simulator sickness; and guidelines for alleviation of simulator sickness. It is concluded that the solution to the problem of simulator sickness may lie in the implementation of advanced algorithms within simulators to detect situations in which sickness is likely to occur. The problem of sickness in simulators may be less severe at present than it could be in the future unless empirically derived guidelines are provided for the design of future systems. AIAA

A93-55945
PHARMACOLOGICAL COUNTERMEASURES AGAINST MOTION SICKNESS
CHARLES D. WOOD (Louisiana State Univ., Shreveport) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 343-351. refs
Copyright

Antimotion sickness drugs for reducing susceptibility to motion sickness are discussed. If used properly, these medications can protect all except the most highly susceptible individuals. The most effective medications are considered to be scopolamine 0.6 mg or promethazine 25 mg. d-Amphetamine 5 to 10 mg and ephedrine 25 mg are also effective, and when combined with scopolamine or promethazine produce an additive effect in prevention of motion sickness. AIAA

A93-55946* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AUTOGENIC-FEEDBACK TRAINING - A TREATMENT FOR MOTION AND SPACE SICKNESS
PATRICIA S. COWINGS (NASA, Ames Research Center, Moffett Field, CA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 353-372. refs
Copyright

A training method for preventing the occurrence of motion sickness in humans, called autogenic-feedback training (AFT), is described. AFT is based on a combination of biofeedback and autogenic therapy which involves training physiological self-regulation as an alternative to pharmacological management. AFT was used to reliably increase tolerance to motion-sickness-inducing tests in both men and women ranging in age from 18 to 54 years. The effectiveness of AFT is found to be significantly higher than that of protective adaptation training. Data obtained show that there is no apparent effect from AFT on measures of vestibular perception and no side effects. AIAA

A93-55947
ADAPTATION TO NAUSEOGENIC MOTION STIMULI AND ITS APPLICATION IN THE TREATMENT OF AIRSICKNESS
J. R. R. STOTT (RAF, Inst. of Aviation Medicine, Farnborough, United Kingdom) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 373-390. refs
Copyright

The incidence of airsickness in aircrew is considered, and the methods adopted to promote adaptation in individuals whose airsickness persists are reviewed. Topics addressed include observations on the RAF airsickness desensitization program, specificity and transferability of adaptation, factors influencing the rate of adaptation, the sensory conflict theory of motion sickness in relation to adaptation, and neurophysiology of adaptation. AIAA

53

BEHAVIORAL SCIENCES

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

A93-52689#
FUTURE MILITARY PILOT TRAINING - A PERSPECTIVE OF INDUSTRY
DIETER ILLAUER (Deutsche Aerospace AG, Munich, Germany) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 306-315.
(AIAA PAPER 93-3601) Copyright

The paper describes the Advanced Training Concept developed by the German Ministry of Defence and gives a perspective for future military pilot training. The training problems related to the training needs and the constraints to training are examined, together with the role of simulation in military pilot training and available training technologies. Future trends are discussed, including increased utilization of synthetic training aids and their mixes; the restructure of training programs in view of the growing use of a broad spectrum of training aids; joint (i.e., industry/military) procurement of training aids and joint training; and establishment of a European training company. AIAA

A93-52694#
COMPUTERIZED TEACHING OF PILOTS TO SPATIAL ORIENTATION FLIGHT TASKS
V. A. PONOMARENKO, A. A. VORONA, D. V. GANDER, and V. M. USOV (Russian Air Force Inst. of Aerospace Medicine, Moscow, Russia) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 337-340. refs
Copyright

The paper discusses components of a computer-based training program for pilots of military aircraft, teaching mental and physical readiness to flight tasks requiring spatial orientation during aircraft maneuvers. The computer simulating system emphasizes the formation of the knowledge of spatial and temporal characteristics of the aircraft acrobatic maneuver; the development of an orientation basis for decision making; training of spatial and temporal perceptions of the aircraft movement on the trajectory; training of the distribution of indicators; the development of anticipated mental tasks; the formation of tactical thinking as a basis of making decisions on optimal maneuver choice under different situation parameters; and the formation of physical readiness to the recovery maneuver of the aircraft under different situations. AIAA

A93-52721* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HUMAN FACTORS WITH NONHUMANS - FACTORS THAT AFFECT COMPUTER-TASK PERFORMANCE
DAVID A. WASHBURN (Georgia State Univ., Atlanta) International Journal of Comparative Psychology (ISSN 0889-3667) vol. 5, no. 4 1992 p. 191-204. Research supported by Georgia State Univ. refs
(Contract NAG2-438; NIH-HD-06016)
Copyright

There are two general strategies that may be employed for 'doing human factors research with nonhuman animals'. First, one may use the methods of traditional human factors investigations to examine the nonhuman animal-to-machine interface. Alternatively, one might use performance by nonhuman animals as a surrogate for or model of performance by a human operator. Each of these approaches is illustrated with data in the present review. Chronic ambient noise was found to have a significant but inconsequential effect on computer-task performance by rhesus monkeys (Macaca mulatta). Additional data supported the generality of findings such as these to humans, showing that rhesus monkeys are appropriate models of human psychomotor performance. It is argued that ultimately the interface between comparative psychology and technology will depend on the coordinated use of both strategies of investigation.

A93-55161
FLIGHT LEADS AND CRISIS DECISION-MAKING
EARL H. MCKINNEY, JR. (U.S. Air Force Academy, Colorado Springs, CO) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 359-362. refs
Copyright

Flight leads of fighter aircraft are typically considered to be superior airmen. However, little research has explicitly studied the decision-making ability of flight leads. In this study, the crisis decision-making of pilots in the role of flight lead is examined. Data from 156 fighter aircraft mechanical breakdown mishaps are used to compare the decision-making of flight leads to that of wingmen. The results suggest decision-making performance of flight

leads is significantly inferior to wingmen. Further, we demonstrate this effect of flight leadership only affects experienced pilots, not inexperienced pilots. Explanations for this counter-intuitive finding include stress, training practices, and communication limitations.

A93-55164
SPACE AND COGNITION - THE MEASUREMENT OF BEHAVIORAL FUNCTIONS DURING A 6-DAY SPACE MISSION
THOMAS BENKE (Univ. Clinic of Neurology, Innsbruck, Austria), O. KOSERENKO (Inst. for Medical-Biological Problems, Moscow, Russia), N. V. WATSON (British Columbia Univ., Vancouver, Canada), and F. GERSTENBRAND (Univ. Clinic of Neurology, Innsbruck, Austria) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 376-379. Research supported by BMFWF refs
Copyright
We measured nonspecific (attention, mental flexibility, psychomotor speed) and visuospatial cognitive processing in a single case study during a 6-d visit on the Russian orbital complex MIR, using computer-based psychometric tasks. Reaction times and accuracy scores showed only minor, nonsignificant changes between preflight, flight, and postflight assessments. These results suggest that several behavioral functions, among them complex visuospatial processing skills, remain essentially intact on short space visits, provided that the performing subject experiences no symptoms of space motion sickness or other physical impairments. Computerized psychometric tasks are a sensitive and flexible tool to measure behavioral functions in space life sciences.

A93-55166
MISHAP TRENDS AND CAUSE FACTORS IN NAVAL AVIATION - A REVIEW OF NAVAL SAFETY CENTER DATA, 1986-90
D. W. YACAVONE (U.S. Navy, Naval Safety Center, Norfolk, VA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 5 May 1993 p. 392-395. refs
Copyright
Although the mishap rate In naval aviation has declined substantially over the period from 1950-90, there remains a residual number of mishaps per 100,000 flight hours. Many of these mishaps represent human error. There seems to be an additional risk in certain air-frames and in specific missions. We reviewed mishap trends and causes for all naval aircraft over a 4-year period, 1986-90. These were graphically represented and compared, beth statistically and with other methods. The mishap rates contained a significant portion of aircrew error mishaps. Of 308 total Class A mishaps, 179 (58 percent) were attributed to aircrew error. There were 145 (47 percent) attributed to supervisory error, another form of human mistakes. Thus, the most common cause factors were directly related to human failure. The effect on training is already being seen with the establishment of aircrew coordination training as one of the top priorities in the Fleet Replacement Squadrons. Studies, both underway and in press, appear to indicate a positive response to this training.

A93-55330
PSYCHOPHYSIOLOGICAL STUDY ON THE EFFECTS OF CO-EXISTENCE OF LINES FOR DETECTING DOT TARGET
KIYOSHI MIZUMOTO (Kyorin Univ., Mitaka, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723) vol. 30, no. 2 June 1993 p. 81-91. In JAPANESE refs
Copyright
The difficulty to detect a small visual target near the frame of the aircraft windshield was demonstrated in two experiments. In the first experiment, a small black dot stimulus was exposed at three different positions for 10, 30, 50, 70, or 90 msec at either side of the central fixation point, with or without a pair of vertical black lines. In the second, visual event-related potentials in response to the dot stimuli exposed for 90 msec were recorded from six scalp electrode sites in eight subjects. In this experiment, two dots, at two different positions, were exposed simultaneously at both sides of the fixation point with or without lines placed at two different positions from the fixation point. The first experiment demonstrated that, with the exposure time, the correct response rates increased while the reaction time decreased, and that the detectability of the dot stimulus near the lines was poorer than that in the white background. In the second experiment, the difference of the amplitude of P 300 components between dot exposure and no-exposure was found to be largest when the dots were exposed without lines. AIAA

A93-55348* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SATIATION OR AVAILABILITY? EFFECTS OF ATTENTION, MEMORY, AND IMAGERY ON THE PERCEPTION OF AMBIGUOUS FIGURES
KRISTA L. HORLITZ (Rutgers Univ., New Brunswick, NJ; NASA, Ames Research Center, Moffett Field, CA) and ANN O'LEARY (Rutgers Univ., New Brunswick, NJ) Perception & Psychophysics (ISSN 0031-5117) vol. 53, no. 6 1993 p. 668-681. Research supported by Rutgers Univ refs
Copyright
The prolonged-inspection technique has been used to demonstrate effects of satiation on the perception of ambiguous figures. We propose that the inspection phase, in which subjects view an unambiguous version of the stimulus prior to observing the ambiguous figure, does not create neural fatigue but rather provides a context in which the alternative percept is apprehended and gains perceptual strength through processes such as imagination or memory. The consequent availability of the alternative organization drives the perceptual phenomena that have been thought to reflect satiation. In Experiment 1, we demonstrated that (1) preexperimental exposure to the target figures and (2) allocation of attention to the inspection figures were both necessary in order to obtain results similar to those predicted by the satiation model. In Experiment 2, we obtained similar results, finding that effects of prior inspection were greater the greater the amount and availability of information regarding the alternative percept during the inspection phase. Subjects who generated visual images of the noninspected alternative during inspection yielded results comparable to those from subjects to whom both versions were presented visually. Author (revised)

A93-55579
SPECTRAL MOTION PRODUCES AN AUDITORY AFTER-EFFECT
Z. J. SHU, N. V. SWINDALE, and M. S. CYNADER (British Columbia Univ., Vancouver, Canada) Nature (ISSN 0028-0836) vol. 364, no. 6439 Aug. 19, 1993 p. 721-723. Research supported by Medical Research Council of Canada and Inst. for Robotics and Intelligent Systems refs
Copyright
An auditory perceptual after-effect analogous to the visual motion after-effect, which is caused by adaptation to auditory spectral (frequency) motion, is reported. After a few minutes of listening to a simple spectral pattern moving upwards or downwards in frequency space, the same pattern sounds as though it is drifting in the opposite direction when it is stationary. The effect shows binaural transfer, from which it is inferred that it is generated at the level after binaural interaction. After-effects produced by the motion of spectral peaks are independent of those produced by spectral notches, suggesting separate processing channels for spectral peaks and notches. AIAA

A93-55948
MOTION SICKNESS SUSCEPTIBILITY AND BEHAVIOR
CHARLES S. MIRABILE, JR. (Sharon Hospital, CT) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 391-410. refs
Copyright
Motion sickness and its place in behavioral theory are discussed with particular attention given to emotional factors in the etiology of motion sickness, nonspecific correlates of motion sickness susceptibility (MSS), and standardized inventories and motion

sickness susceptibility. Also discussed are cognitive, perceptual, and sensory correlates of MSS, MSS and psychopathology, and some general observations on MSS and behavior. AIAA

A93-55949
MOTION AND HUMAN PERFORMANCE
LAWRENCE J. HETTINGER, ROBERT S. KENNEDY (Essex Corp., Orlando, FL), and MICHAEL E. MCCAULEY (Monterey Technologies, Inc., Carmel, CA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 411-441. Research supported by U.S. Navy and DOE refs
Copyright

Available literature on performance in connection with motion and motion sickness is reviewed. Emphasis is placed on operational environments, experimental and laboratory studies based on linear oscillation and rotation, and a proposed model. It is concluded that there is a considerable amount of confusion as to whether performance is or is not disrupted, and when it is, as to whether the disruption is due to the motion, motion sickness, or some other factors. AIAA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A93-52661#
WHAT OPTICAL CUES DO PILOTS USE TO INITIATE THE LANDING FLARE? RESULTS OF A PILOTED SIMULATOR EXPERIMENT
S. K. ADVANI, J. C. VAN DER VAART, R. TH. RYSDYK, and J. GROSZ (Delft Univ. of Technology, Netherlands) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 81-89. refs
(AIAA PAPER 93-3561) Copyright

A piloted moving-base simulator study of the landing of a twin-engined executive jet airplane was conducted to find out if pilots also use an optical variable called the Time-To-Contact (TTC) or tau, to time their actions. By manipulating the approach-path angle and the visual speed of the visible runway outline, the influence of the perceived TTC on the initiation of the landing was assessed. Results suggest that pilots indeed use some kind of Tau-margin strategy, but rely on the judgement of absolute height as well. Further experiments are needed to rule out any influence of prior training on the timing of the flare. Recent work on timing and perception suggests that the amplitude or speed of control actions may be determined by a higher order variable, i.e., the perceived rate of change of the Time-To-Contact, called Tau-dot. Possible implications of this for further work are mentioned.

A93-52662#
ACOUSTICAL AND VIBRATORY STIMULI INTERDEPENDENCIES AND THEIR APPLICATIONS IN SIMULATION AND CUE SYNCHRONIZATION
ROBERT J. SAWLER and RON MATUSOF (CAE-Link Corp., Binghamton, NY) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 90-94. refs
(AIAA PAPER 93-3562) Copyright

The performance measurements of the simulator's secondary cues have many unique issues not previously addressed. This paper focuses on two of the secondary cues: the aural cue system and the vibrational cue systems. This paper provides a brief look at classical cue synchronization and cue correlation of the primary cues. Next, it introduces the issues concerning the inter-dependencies between the aural cue system and the vibrational cue system. Finally, it discusses the importance of the secondary cues to the cue synchronization and cue correlation in simulation.
Author (revised)

A93-52664#
MULTISTAGE INTEGRATION MODEL FOR HUMAN EGOMOTION PERCEPTION
GREG L. ZACHARIAS, ADAM X. MIAO (Charles River Analytics, Inc., Cambridge, MA), and RIK WARREN (USAF, Armstrong Lab., Wright-Patterson AFB, OH) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 103-113. refs
(Contract F41624-92-C-6007)
(AIAA PAPER 93-3564) Copyright

Human computational vision models which attempt to account for the dynamic perception of egomotion and relative depth typically assume a linear architecture for image processing. A common three-stage structure is as follows: first, compute the optical flowfield based on the dynamically changing image; second, estimate the egomotion states based on the flow; and third, estimate the relative depth/shape, based on the egomotion states. We propose an architecture more in line with recent work in human vision, employing multistage integration. Here the dynamic image is first processed to generate spatial and temporal image gradients which are then transformed into snapshot estimates to be used by the downstream egomotion state estimator. The estimator uses these snapshot estimates, in combination with a depth/shape estimate of the viewed surface, to generate current state estimates. These, in turn, drive the depth/shape estimator, which employs an internal model of the world geometry, to generate an output which loops back to the state estimator. We describe this model and its implications for modeling human egomotion perception, and compare model predictions with observed data.
Author (revised)

A93-52666*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LINE-OF-SIGHT DETERMINATION IN REAL-TIME SIMULATIONS
FREDERICK G. KULL, JR. and DONALD E. FOUGHT (SYRE; NASA, Ames Research Center, Moffett Field, CA) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 123-132. refs
(AIAA PAPER 93-3567) Copyright

This paper describes the selection of a method for determining line-of-sight in real-time simulations for the NASA Ames Vertical Motion Simulator (VMS) facility. Five different combinations of terrain representation and line-of-sight determination algorithms were tested. A gridpost terrain format, in conjunction with a Digital Differential Analyzer algorithm, was found to best meet the simulation criteria of high speed, low storage requirements, and accuracy.

A93-52669#
A COMPARATIVE EVALUATION OF THREE TAKE-OFF PERFORMANCE MONITOR DISPLAY TYPES
J. J. L. H. VERSPAY and R. KHATWA (National Aerospace Lab., Amsterdam, Netherlands) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 147-155. Research supported by Netherlands Agency for Aerospace Programmes refs
(AIAA PAPER 93-3608) Copyright

This paper focuses on a pilot-in-the-loop part-task simulation trails aimed at establishing the relative merits of three alternative Take-Off Performance Monitor (TOPM) display types when compared to take-offs conducted without the aid of a TOPM. For many years it has been realized that a TOPM could potentially enhance take-off safety. There has been considerable activity

aimed at developing a reliable TOPM during recent years at NASA Langley, Bristol University and the NLR. However a widely acceptable solution still has to emerge. Fundamental to the objective of this investigation is to establish whether a TOPM (and what type) could actually improve pilot decision making. Qualitative (i.e., questionnaires) and quantitative (i.e., measured pilot performance) results of the simulation study are presented herein. Results show that a TOPM is able to enhance Go/No-Go judgement in certain take-offs where a performance deficit is present. A so-called type III system, which has the ability to predict both continued take-off status and stopping performance, offers the largest potential with respect to improving take-off safety.

A93-52674#
FALSE CUE DETECTION THRESHOLDS IN FLIGHT SIMULATION
RUUD J. A. W. HOSMAN and HAN F. A. M. VAN DER STEEN (Delft Univ. of Technology, Netherlands) *In* AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 9-11, 1993, Technical Papers Washington American Institute of Aeronautics and Astronautics 1993 p. 193-201. Research supported by NWO refs
(AIAA PAPER 93-3578) Copyright

A new experimental method is presented for the design of motion filters, based on simple concepts using a multisensory perception model. We will present the results of recent research on the perception thresholds for differences in the visual and vestibular cues as determined by using a sled as well as a research flight simulator for linear motions (surge and heave). These differences will be called false cues. Peripheral visual cues are modulated relative to the vestibular cues to determine the threshold values. The thresholds turn out to be dependent on velocity magnitude. The no-motion ranges turn out to be so large that they are useful in simulation.

A93-52764* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HUMAN-CENTERED AUTOMATION AND AI - IDEAS, INSIGHTS, AND ISSUES FROM THE INTELLIGENT COCKPIT AIDS RESEARCH EFFORT
KATHY H. ABBOTT and PAUL C. SCHUTTE (NASA, Langley Research Center, Hampton, VA) Aug. 1989 9 p. International Joint Conference on Artificial Intelligence, Workshop on Integrated Human Machine Intelligence, Detroit, MI, Aug. 1989, Paper refs

A development status evaluation is presented for the NASA-Langley Intelligent Cockpit Aids research program, which encompasses AI, human/machine interfaces, and conventional automation. Attention is being given to decision-aiding concepts for human-centered automation, with emphasis on inflight subsystem fault management, inflight mission replanning, and communications management. The cockpit envisioned is for advanced commercial transport aircraft. AIAA

A93-52867
CONTROL OF INFECTION IN AN INTERNATIONAL AIRLINE
M. KELLY (British Airways, PLC, Health Services, Hounslow, United Kingdom) Occupational Medicine (UK) (ISSN 0962-7480) vol. 43, no. 2 May 1993 p. 9-14.
Copyright

The paper examines the possible sources of infection on an international aircraft, including the provision of food, the supply of drinking water, and the removal of waste. It considers aspects of control, and explains some of the steps which have to be taken by a major international carrier to ensure that the high quality expected by the customer is provided in all areas of the world, even those where natural resources and expertise may be limited. The emphasis is on providing a safe product, and removing any possible risk of infection of the passengers.

A93-52915* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEPTH-VIEWING-VOLUME INCREASE BY COLLIMATION OF STEREO 3-D DISPLAYS
ANTHONY M. BUSQUETS, RUSSELL V. PARRISH, and STEVEN P. WILLIAMS (NASA, Langley Research Center, Hampton, VA) Apr. 1990 5 p. IEEE Southeastcon '90, New Orleans, LA, Apr. 1-4, 1990, Paper refs

Typical stereo 3-D displays are produced using a single-image-source, which is time-multiplexed, to present disparate, directly-viewed views (stereo pairs) of the visual scene to each eye. However, current stereoscopic viewing techniques impose severe restrictions in the effective viewing-volume of the stereo 3-D display. Recent experiments at Langley Research Center determined that the effective region of stereopsis cuing, the depth-viewing volume, increased with increasing viewer-to-screen distances. This increase was also accompanied by a decrease in the field-of-view of the system. It was postulated that collimation of the display source would dramatically increase the depth-viewing volume, as the effective accommodation distance would be near infinity, while maintaining the field-of-view at required levels. The goal of this proof-of-concept effort was to investigate whether or not a dramatic increase in depth-viewing volume for stereo 3-D displays would be provided by the application of collimated optics to the stereo display source.

A93-52916* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IN-SIMULATOR ASSESSMENT OF TRADE-OFFS ARISING FROM MIXTURE OF COLOR CUING AND MONOCULAR, BINOPTIC, AND STEREOPSIS CUING INFORMATION
STEVEN P. WILLIAMS and RUSSELL V. PARRISH (NASA, Langley Research Center, Hampton, VA) Apr. 1990 7 p. IEEE Southeastcon '90, New Orleans, LA, Apr. 1-4, 1990, Paper refs

The use of monochrome Helmet Mounted Display (HMD) systems is becoming prevalent in today's complex flight mission environment. These HMD systems can provide stereopsis cueing as an almost natural byproduct for binocular helmet systems of an additional image generation source is provided. The addition of color cueing capability is much more difficult. The application of stereopsis cueing to advanced HMD and heads-down flight display concepts has demonstrated gains in pilot situation awareness and improved task performance. To provide stereopsis, binocular HMD systems must trade some of the total field-of-view (FOV) available from their two monocular fields to obtain a partial overlap region. The visual field then provides a mixture of cues, with monocular regions on both peripheries, and, in the overlapped center, a binoptic (the same image to both eyes) or, if lateral disparity is introduced to produce two images, a stereo region. The goal of this research was to assess the trade-offs arising from the mixture of color cueing and monocular, biocular, and stereopsis cueing information in peripheral monitoring displays as encountered in HMD systems. The accompanying effect of stereopsis cueing in the foveal display of tracking information was also assessed.

A93-53038* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
JOINT-SPACE LYAPUNOV-BASED DIRECT ADAPTIVE CONTROL OF A KINEMATICALLY REDUNDANT TELEROBOT MANIPULATOR
CHARLES C. NGUYEN, ZHEN-LEI ZHOU (Catholic Univ. of America, Washington), and GARY E. MOSIER (NASA, Goddard Space Flight Center, Greenbelt, MD) Control and Computers (ISSN 0315-8934) vol. 21, no. 1 1993 p. 23-27. refs
Copyright

This paper presents the design of a joint-space adaptive control scheme for controlling the slave arm motion of a dual-arm telerobot system developed at Goddard Space Flight Center (GSFC) to study telerobotic operations in space. Each slave arm of the dual-arm system is a kinematically redundant manipulator with seven degrees of freedom (DOF). Using the concept of model reference adaptive control (MRAC) and Liupunov direct method, we derive an adaptation algorithm that adjusts the PD controller gains of the control scheme. The development of the adaptive control scheme assumes that the slave arm motion is non-compliant and slowly varying. The implementation of the derived control

scheme does not require the computation of manipulator dynamics which makes the control scheme sufficiently fast for real-time applications. Computer simulation study performed for the 7-DOF slave arm shows that the developed control scheme can efficiently adapt to sudden change in payload while tracking various test trajectories such as ramp or sinusoids with negligible position errors.

A93-53119
STEREOSCOPIC DISPLAYS AND APPLICATIONS III; PROCEEDINGS OF THE MEETING, SAN JOSE, CA, FEB. 12, 13, 1992
JOHN O. MERRITT, ED. (Interactive Technologies, Williamsburg, MA) and SCOTT S. FISHER, ED. (Telepresence Research, Palo Alto, CA) Bellingham, WA Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1669) 1992 277 p. For individual items see A93-53120 to A93-53125
(SPIE-1669; ISBN 0-8194-0823-9) Copyright

The present volume on stereoscopic displays and applications discusses stereoscopic display software and display applications issues, new developments in stereoscopic displays, and virtual environments applications of stereoscopic displays. Attention is given to distortions in stereoscopic displays, minimizing absolute parallax in a stereo image, problems with lossy compression of stereo pairs, and combining motion blur and stereo. Topics addressed include temporal sampling requirements for stereoscopic displays, adaptation effects in stereo due to on-line changes in camera configuration, effects of test structure on depth perception measurement tasks, and 3D target designation using two control devices and an aiding technique. Also discussed are monitor selection criteria for stereoscopic displays, the future of autostereoscopic electronic displays, a low-cost helmet-mounted camera/display system for field testing teleoperator tasks, the measurement and calibration of static distortion of position data from 3D trackers, and a virtual environment display for a 3D audio room simulation. AIAA

A93-53120
3-D TARGET DESIGNATION USING TWO CONTROL DEVICES AND AN AIDING TECHNIQUE
JOHN M. REISING, KRISTEN K. LIGGETT, CHRIS RATE (USAF, Wright Lab., Wright-Patterson AFB, OH), and DAVID C. HARTSOCK (Midwest Systems Research, Inc., Dayton, OH) *In* Stereoscopic displays and applications III; Proceedings of the Meeting, San Jose, CA, Feb. 12, 13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 146-154. refs
Copyright

One of the objectives of this study was to determine which of two cursor control devices would provide the best means of designating targets in stereo three-dimensional (3-D) space. The two devices tested were a joystick and a hand tracker. The second objective was to determine if performance improved with the use of an aiding technique to designate the targets. This aid was incorporated by changing the color of the cursor when it penetrated the target volume. The total 3-D viewing volume was divided into four perceived depth volumes within which the targets could appear. The study showed that the quickest designations occurred when using the hand tracker, and the hand tracker performed significantly better than the joystick when the targets were located in the two volumes behind the screen. There was no difference in accuracy for the two devices. Also, the use of the aiding technique was most effective (target designation time and accuracy) in the farthest behind depth volume and the front-most depth volume. Performance in the other depth volumes showed no advantage of aiding.

A93-53121
HIGH-RESOLUTION INSERTS IN WIDE-ANGLE HEAD-MOUNTED STEREOSCOPIC DISPLAYS
ERIC M. HOWLETT (LEEP Systems, Inc., Waltham, MA) *In* Stereoscopic displays and applications III; Proceedings of the Meeting, San Jose, CA, Feb. 12, 13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 193-203. refs
Copyright

Attention is given to two developments to raise industry standards in radial imaging compressing optics. The first increases the lateral FOV by 25 deg (CYBERFACE2), and the second adds an optical high-resolution insert. Because the insert is added optically in the head-mount, the smaller the insert, the sharper its detail. The parameters of the dual-resolution CYBERFACE, the optical geometry of the system, and system packaging are discussed. AIAA

A93-53122
A LOW COST HELMET-MOUNTED CAMERA/DISPLAY SYSTEM FOR FIELD TESTING TELEOPERATOR TASKS
ROBERT E. COLE, CURTIS IKEHARA (Hawaii Univ., Honolulu), and JOHN O. MERRITT (Interactive Technologies, Williamsburg, MA) *In* Stereoscopic displays and applications III; Proceedings of the Meeting, San Jose, CA, Feb. 12, 13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 228-235. Research supported by Univ. of Hawaii refs
Copyright

A low cost helmet-mounted stereoscopic color viewing system designed for field testing teleoperator tasks is described. A stereo camera pair was mounted on a helmet to allow testing of a helmet-mounted display with real time video input. The display consisted of a pair of LCD color monitors viewed through a modified Wheatstone mirror system. The components were arranged on a stable platform that was attached to a hard plastic helmet. The helmet weight (9.5 pounds) was supported by a modified backpack. This backpack also contained support electronics and batteries. Design, construction and evaluation tests of this viewing system are discussed.

A93-53123
USER EVALUATION OF A STEREOSCOPIC DISPLAY FOR SPACE TRAINING APPLICATIONS
ARTHUR M. GORSKI (Mitre Corp., Houston, TX) *In* Stereoscopic displays and applications III; Proceedings of the Meeting, San Jose, CA, Feb. 12, 13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 236-243. refs
Copyright

A prototype stereoscopic out-the-window display system coupled with a supergraphic workstation to provide a true 3D scene is described. The system has been used with visual scene database models of a Space Station Freedom cupola crewstation mockup to produce a prototype on-orbit stimulation. Conclusions about the system performance, user acceptability, and suitability for the application are drawn on the basis of evaluations of the system by the potential users. Space Station applications that may benefit from the use of a true 3D stereo display system include stereo camera systems, extravehicular activities, and near-field out-the-window training. AIAA

A93-53125* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VIRTUAL ENVIRONMENT DISPLAY FOR A 3D AUDIO ROOM SIMULATION
WILLIAM L. CHAPIN (Telepresence Research, Palo Alto, CA) and SCOTT H. FOSTER (Crystal River Engineering, Palo Alto, CA) *In* Stereoscopic displays and applications III; Proceedings of the Meeting, San Jose, CA, Feb. 12, 13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 256-267. Research supported by NASA refs
Copyright

The development of a virtual environment simulation system integrating a 3D acoustic audio model with an immersive 3D visual scene is discussed. The system complements the acoustic model and is specified to: allow the listener to freely move about the space, a room of manipulable size, shape, and audio character, while interactively relocating the sound sources; reinforce the listener's feeling of telepresence in the acoustical environment with visual and proprioceptive sensations; enhance the audio with

the graphic and interactive components, rather than overwhelm or reduce it; and serve as a research testbed and technology transfer demonstration. The hardware/software design of two demonstration systems, one installed and one portable, are discussed through the development of four iterative configurations. AIAA

A93-53746* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HUMAN FACTORS EVALUATION OF THE HL-20 FULL-SCALE MODEL
KELLI F. WILLSHIRE, LISA C. SIMONSEN, and WILLIAM L. WILLSHIRE, JR. (NASA, Langley Research Center, Hampton, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650) vol. 30, no. 5 Sept.-Oct. 1993 p. 606-614. refs
Copyright

The human factors testing of the HL-20 personnel launch system full-scale model was conducted in both the vertical and horizontal positions at NASA Langley Research Center. Three main areas of testing were considered: an anthropometric fit evaluation, the ingress and egress of a 10-person crew, and pilot viewing. The subjects, ranging from the 5th to 95th percentile size, had sufficient clearance in the model, with the exception of the last two rows of seats and the cockpit area. Adjustable seat heights and/or placement of the seats farther forward would provide more headroom. In the horizontal position, the model's seat placement and aisle width allowed a quick and orderly 10-person egress for the no-keel (a structural support running the length on the aisle), 6-in.-high keel, and 12-in.-high keel conditions. Egress times were less than 20 s. For the vertical position, the model's long cylindrical shape with the ladder in the ceiling allowed a quick and orderly egress with average times less than 30 s. Ingress and egress procedures were demonstrated using Shuttle partial-pressure suits. The reduced mobility experienced while wearing the suits did increase egress times, although they still remained acceptable. The window arrangement for pilot viewing was found to be reasonably acceptable, although slight modifications, such as an increased downward view, is desirable.

A93-54158* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTELLIGENT SENSING AND CONTROL FOR ADVANCED TELEOPERATION
SUKHAN LEE (JPL, Pasadena; Southern California Univ., Los Angeles, CA) IEEE Control Systems Magazine (ISSN 0272-1708) vol. 13, no. 3 June 1993 p. 19-28. refs
Copyright

A theoretical framework is presented for a 'sensing-knowledge command-fusion' paradigm of interactive and cooperative sensing and control in advanced teleoperators, which takes advantage of both current and projected robotic dexterousness and sensor-based autonomy capabilities. Attention is given to (1) a method for the achievement of a sensing-knowledge-command computational mechanism that implements the intended cooperative/interactive system, and (2) the system architecture and man/machine-interface protocols entailed by this implementation. AIAA

A93-54308
LIFE SUPPORT SYSTEMS
NORMAN N. LI (Allied-Signal, Inc., Des Plaines, IL) *In* Humans and machines in space: The vision, the challenge, the payoff; Proceedings of the 29th Goddard Memorial Symposium, Washington, Mar. 14, 15, 1991 San Diego, CA Univelt, Inc. 1992 p. 79-85. refs
(AAS PAPER 91-320) Copyright

An account is given of the conceptual development status of an environmental control and life support system's (ECLSS) use for atmosphere revitalization, water management, and urine treatment. The ECLSS envisioned accomplishes CO2 removal and reduction to oxygen using either a Bosch or Sabatier reactor, and multifiltration of condensates to obtain potable water. Urine is treated by vapor-compression distillation. An effort has been made in these conceptual-definition efforts to look beyond Space Station Freedom requirements to even longer-duration space missions, such as those involved in planetary exploration. AIAA

A93-54410
HUMAN FACTORS APPLICATIONS IN CONTROL SYSTEMS DESIGN FOR GROUND TESTING OF TURBINE ENGINES
CURTIS L. WALTERS and JACK L. WELCH (Sverdrup Technology, Inc., Arnold AFB, TN) *In* International Instrumentation Symposium, 39th, Albuquerque, NM, May 2-6, 1993, Proceedings Research Triangle Park, NC Instrument Society of America 1993 p. 1123-1130. refs
Copyright

This paper presents our efforts to radically upgrade the control systems and control rooms for the turbine engine test units at the Arnold Engineering Development Center, TN, and how we emphasized human factors throughout the upgrade effort, beginning with conceptual design. Altitude testing of turbine engines in ground test facilities requires numerous complex and highly reliable controls to satisfy present-day integrated test demands. These engine test facilities were constructed primarily in the early 1950s. Although individual control systems had undergone continual improvements, basic controls approaches remained the same and were based more on equipment availability/needs than on those of the human. With a goal of increasing productivity, we used human factors standards in the design and selection of hardware/software, system control station layout, room layout, and man-machine interfaces. The human factors considerations, including overall working environment, promoted acceptance by operations personnel of major new technology and approach changes. Author (revised)

A93-54826* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INCINERATION FOR RESOURCE RECOVERY IN A CLOSED ECOLOGICAL LIFE SUPPORT SYSTEM
R. S. UPADHYE (ARU Associates, Pleasanton, CA), K. WIGNARAJAH (Bionetics Corp.; NASA, Ames Research Center, Moffett Field, CA), and T. WYDEVEN (NASA, Ames Research Center, Moffett Field, CA) Environment International (ISSN 0160-4120) vol. 19 1993 p. 381-392. refs
Copyright

A functional schematic, including mass and energy balance, of a solid waste processing system for a controlled ecological life support system (CELSS) was developed using Aspen Plus, a commercial computer simulation program. The primary processor in this system is an incinerator for oxidizing organic wastes. The major products derived from the incinerator are carbon dioxide and water, which can be recycled to a crop growth chamber (CGC) for food production. The majority of soluble inorganics are extracted or leached from the inedible biomass before they reach the incinerator, so that they can be returned directly to the CGC and reused as nutrients. The heat derived from combustion of organic compounds in the incinerator was used for phase-change water purification. The waste streams treated by the incinerator system conceptualized in this work are inedible biomass from a CGC, human urine (including urinal flush water) and feces, humidity condensate, shower water, and trash. It is estimated that the theoretical minimum surface area required for the radiator to reject the unusable heat output from this system would be 0.72 sq m/person at 298 K. Author (revised)

A93-54845* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTEGRATED TOOLS FOR TELEOPERATED SATELLITE REPAIR
H. DAS and P. FIORINI (JPL, Pasadena, CA) Automation in Construction (ISSN 0926-5805) vol. 2, no. 1 1993 p. 81-89. refs
Copyright

Tools and tool handling techniques designed for demonstrating the use of the Advanced Teleoperation System at JPL in satellite repair operations are described in this paper. Our model for the repair demonstration is the Main Electronics Box (MEB)

replacement on the Solar Maximum Satellite Repair (SMSR) procedure developed by NASA and successfully performed by the crew of Space Shuttle STS-13 in 1984. A summary of the repair procedure consists of uncovering thermal protection blankets on the satellite, removing screws from the MEB panel, opening the panel and clamping it in place, then removing electrical connectors from their sockets, cutting cords that hold electrical cables to the MEB panel, replacing the panel, and finally reversing the previous procedures. Methods for handling tools used in our SMSR procedure, along with details of the tool designs are discussed in this paper.

A93-54868
VIRTUAL LANDINGS
DAVID LEARMOUNT Flight International (ISSN 0015-3710) vol. 144, no. 4380 July 28, 1993 p. 40-42.
Copyright

The role of human factors in the use of enhanced-vision systems (EVS) and synthetic vision systems (SVS) in aircraft landings is discussed. The proper presentation of EVS/SVS displays is examined. Design questions pertaining to new EVS/SYS equipment are addressed, in particular where the HUD picture of the approach should be a visual image, a runway-profile icon, or a combination of the two. Approaches for dealing with runway visibility problems are addressed. AIAA

A93-54874
HUMAN ENGINEERING ISSUES FOR DATA LINK SYSTEMS
SAE Aerospace Resource Document SAE ARD 50057 May 31, 1991 32 p. refs
(SAE ARD 50027) Copyright

The paper discusses the human engineering issues, problems, and requirements for implementation of data link systems as these issues were considered by the SAE Subcommittee G-10K. Particular attention is given to the pilot/controller interface with the data and to the issues that are factors which can affect this interface and the way the information is provided to the crew. It is emphasized that changes in training may be required to insure that the system is effective, and that training should not be used to teach pilots to interpret information in ways that are counterintuitive or to respond in ways that are incompatible with other necessary activities. AIAA

A93-54887* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HUMAN EXPOSURE TO GALACTIC COSMIC RAYS IN SPACE
L. W. TOWNSEND, F. A. CUCINOTTA, J. L. SHINN, and J. W. WILSON (NASA, Langley Research Center, Hampton, VA) *In* International Congress of Radiation Research, 9th, Toronto, Canada, July 7-12, 1991, Proceedings. Vol. 2 San Diego, CA Academic Press, Inc. 1992 p. 487-492. refs
Copyright

The Langley Research Center GCR (galactic cosmic rays) code (HZETRN) and the computerized Anatomical Man (CAM) model are used to estimate astronaut exposures, from GCR particles, for missions beyond earth's magnetosphere. Conventional risk assessments in terms of total absorbed dose and dose equivalent are made for skin, ocular lens, and bone marrow. For each organ, evaluations are made of relative contributions from incident protons, iron nuclei, and their secondary reaction products. AIAA

A93-55334
THE PROBLEM OF THE PILOT'S PROFESSIONAL RELIABILITY [K VOPROSU O PROFESSIONAL'NOJ NADEZHNOSTI LETCHIKA]
A. M. VOJTENKO and K. V. PONOMARENKO Voenno-Meditsinskij Zhurnal (ISSN 0026-9050) no. 5 May 1993 p. 51-53. In RUSSIAN refs
Copyright

The paper examines the concept of the professional reliability as related to piloting activity, together with its indicators and components and the factors necessary for its maintenance. It is shown that the reliability components comprise two interrelated factors: the activity of the pilot, especially under new circumstances, and the physiological state of the subject and his stability under new conditions of work. It is emphasized that periodic medical tests of the pilots' health and work capacity should include long-term monitoring of both the physiological and psychological health parameters. AIAA

A93-55469* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REMOTE SURFACE INSPECTION SYSTEM
SAMAD HAYATI, J. BALARAM, HOMAYOUN SERAJI, WON S. KIM (JPL, Pasadena, CA), and KAM S. TSO (SoHar Corp., Beverly Hills, CA) Robotics and Autonomous Systems (ISSN 0921-8890) vol. 11, no. 1 May 1993 p. 45-59. Previously announced in STAR as N93-32099 refs
Copyright

This paper reports on an on-going research and development effort in remote surface inspection of space platforms such as the Space Station Freedom (SSF). It describes the space environment and identifies the types of damage for which to search. This paper provides an overview of the Remote Surface Inspection System that was developed to conduct proof-of-concept demonstrations and to perform experiments in a laboratory environment. Specifically, the paper describes three technology areas: (1) manipulator control for sensor placement; (2) automated non-contact inspection to detect and classify flaws; and (3) an operator interface to command the system interactively and receive raw or processed sensor data. Initial findings for the automated and human visual inspection tests are reported.

A93-55838
OPTIMAL MANIPULATOR TRAJECTORIES FOR SPACE ROBOTS
SEIYA UENO (Yokohama National Univ., Japan), TAKASHI KIDA, ISAO YAMAGUCHI (National Aerospace Lab., Chofu, Japan), and MASAKI TANAKA (Toshiba Corp., Kawasaki, Japan) *In* International Space Year in the Pacific basin; Proceedings of the 4th International Space Conference of Pacific-basin Societies, Kyoto, Japan, Nov. 17-20, 1991 San Diego, CA Univelt, Inc. 1992 p. 629-639.
(AAS PAPER 91-669) Copyright

The optimal trajectories for manipulators attached to a space robot of the flying type are presented. Space robots are assumed to consist of a central body and a manipulator, and to move in a 2D plane. The dynamics are described in equations of motion whose input variables are one attitude control torque and three joint torques. A simple logic to calculate optimal or suboptimal trajectories without a great number of calculations is obtained. A preliminary phase is explained, and the tendency of optimal trajectories is demonstrated. It is shown that changes in the criteria or in the position of the traget affect optimal trajectories. When a target is specified far from a center body, the angle of a third joint stretches at the terminal time. The variation of target positions in a particular direction causes a rotational movement of the body. AIAA

A93-55938
THE ACCELERATIVE STIMULUS FOR MOTION SICKNESS
J. C. GUIGNARD (Guignard Biodynamics, Metairie, LA) and M. E. MCCAULEY (Monterey Technologies, Inc., Carmel, CA) *In* Motion and space sickness Boca Raton, FL CRC Press, Inc. 1990 p. 123-152. refs
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Experimental studies of the accelerative stimulus for motion sickness are reviewed, and current knowledge on the accelerative stimulus is summarized. Particular attention is given to the Wesleyan University Experiments and studies conducted in the Office of Naval Research/Human Factors Research; characteristics of the primary stimulus for motion sickness, and secondary provocative or influential factors. Also discussed are criteria and standards for low-frequency motion exposure and human factors engineering principles for preventing motion sickness. AIAA

A93-56254
RESEARCH OF A FREE-FLYING TELEROBOT. IV - DEVELOPMENT OF DUAL-ARM MANIPULATION SYSTEM
YOSHITSUGU TODA, TOSHIAKI IWATA, KAZUO MACHIDA (Electrotechnical Lab., Tsukuba, Japan), NABUTO MATSUHIRA, YASUSHI FUKUDA, MAKOTO ASAKURA, MICHIHIRO UENOHARA, and AKIKO OHTSUKA (Toshiba Corp., Kawasaki, Japan) *In* Space Sciences and Technology Conference, 35th, Nagaoka, Japan, Oct. 28-31, 1991, Proceedings Tokyo Japan Society for Astronautical and Space Sciences 1991 p. 9, 10. In JAPANESE refs

A dual-arm manipulation system was developed to be installed in the flying unit of the free-flying robot. The system consists of a dual-arm, a capture unit, and a controller. It is designed to be controlled by commands in following modes, the position control, the force control, the dual-arm cooperative control, and the target tracking using the proximity sensor. All actions of the system were ascertained experimentally. Author (revised)

A93-56255
RESEARCH OF A FREE-FLYING TELEROBOT. V - HANDLING A TARGET WITH MULTI-ARMS
YOSHITUGU TODA, TOSHIAKI IWATA, KAZUO MACHIDA (Electrotechnical Lab., Tsukuba, Japan), MAKOTO ASAKURA, YASUSI FUKUDA, and AKIKO OOTUKA (Toshiba Corp., Kawasaki, Japan) *In* Space Sciences and Technology Conference, 35th, Nagaoka, Japan, Oct. 28-31, 1991, Proceedings Tokyo Japan Society for Astronautical and Space Sciences 1991 p. 11, 12. In JAPANESE

This report presents manipulation and handling topics of an ongoing program for a research and development of a free-flying telerobot for space use. A developed ground experiment model has two manipulators and a capturing mechanism. A sensory feed back control method enables impedance and active limp control of manipulators. We conclude that these control methods are effective when the telerobot catches a target with a manipulator, moves with a manipulator or manipulators, transfers one manipulator to another, or transfers manipulators to a capturing mechanism. Author (revised)

A93-56256
TELEMANIPULATION EXPERIMENT USING PREDICTIVE DISPLAY
KOHTARO MATSUMOTO (National Aeronautical Lab., Chofu, Japan), SHINYA OGISO (Ebara Research Co., Ltd., Fujisawa, Japan), and KEIGO IWASAKI (NASEC, Japan) *In* Space Sciences and Technology Conference, 35th, Nagaoka, Japan, Oct. 28-31, 1991, Proceedings Tokyo Japan Society for Astronautical and Space Sciences 1991 p. 15, 16. In JAPANESE

For space robots teleoperation, time delay and channel capacity between the robot on-orbit and the ground operation station are the essential factors. Predictive display has been proposed to reduce the time delay effect. This paper describes an experimental result using a relatively plain system, and shows that predictive display approach will work well for a large time delay and slow command cycle using only the positioning commands. Author (revised)

A93-56260
SKILL COMPENSATION AND DYNAMIC COUPLING OF MACRO/SMART EFFECTOR SYSTEM
KAZUO MACHIDA, YOSHITSUGU TODA, and TOSHIAKI IWATA (Electrotechnical Lab., Tsukuba, Japan) *In* Space Sciences and Technology Conference, 35th, Nagaoka, Japan, Oct. 28-31, 1991, Proceedings Tokyo Japan Society for Astronautical and Space Sciences 1991 p. 25, 26. In JAPANESE refs

A smart end effector was developed to add dexterous and flexible capability to a long space manipulator arm. It provides fine adjustment for precise error compensation and delicate force control by a remote-end sensor feedback. The performance of the skill compensation and the dynamic coupling problem between the long arm and the smart end effector are examined. Author (revised)

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A93-53286
FORMATION OF REDUCED CARBONACEOUS MATTER IN BASALTS AND XENOLITHS - REACTION OF C-O-H GASES ON OLIVINE CRACK SURFACES
TRACY N. TINGLE (Stanford Univ.; SRI International, Molecular Physics Lab., Menlo Park, CA) and MICHAEL F. HOCHELLA, JR. (Stanford Univ., CA) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3245-3249. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 Research supported by Gas Research Inst refs
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It has been suggested that the formation of reduced carbonaceous matter in basalts and mantle xenoliths occurs by heterogeneous reaction of volcanic gas on fresh, chemically active crack surfaces produced by thermal stresses during eruption and cooling. This hypothesis is supported by experiments at 400-800 C on 010-plane surfaces of San Carlos olivine exposed to C-O-H gases generated by the decomposition of oxalic acid and oxalic acid dihydrate. Carbonaceous films form readily on these surfaces and achieve thicknesses comparable to those observed in natural samples in a matter of minutes. At relatively oxidizing conditions, the carbonaceous films consist principally of C-C and C-H bonded species with lesser amounts of C-O bonded species. At relatively reducing conditions, the carbonaceous films consist of subequal amounts of C-C/C-H, C-O, and metal-C species. Aliphatic and aromatic hydrocarbons and other thermally labile organic species are associated with carbonaceous films in some natural samples but none were detected in experimental samples from this study, leaving open the question of abiotic synthesis of organic matter on crack surfaces in basalts. Regardless, it is clear from the preliminary experiments reported here that crack surfaces in olivine (and probably other silicate minerals and glasses) are capable of stabilizing compounds that otherwise would not be stable in cooling lava.

A93-53289
KINETICS OF PEPTIDE HYDROLYSIS AND AMINO ACID DECOMPOSITION AT HIGH TEMPERATURE
YAORONG QIAN, MICHAEL H. ENGEL (Oklahoma Univ., Norman), STEPHEN A. MACKO (Virginia Univ., Charlottesville), SHELLY CARPENTER, and JODY W. DEMING (Washington Univ., Seattle) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3281-3293. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 refs
(Contract NSF EAR-91-18011)
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Dipeptide hydrolysis and amino acid decomposition appear to follow a first-order rate law. The hydrolysis rate increases exponentially with increasing temperature in aqueous solution at both 265 atm and water steam pressures over the temperature range of 100 to 220 C. Dipeptide hydrolysis has a lower apparent activation energy at 265 atm (44.1 KJ/mol) than at water steam pressure (98.9 KJ/mol). At lower temperatures (less than 200-220 C), the rate of peptide bond hydrolysis is faster at 265 atm than at water steam pressure. At higher temperatures (greater than 200-220 C), however, peptide bond hydrolysis is slower at 265 atm than at water steam pressure. In aqueous solution, amino acid decomposition rates also increase exponentially with increasing temperature. Amino acid decomposition rates are much higher at 265 atm than at water steam pressure over the entire temperature range investigated. Author (revised)

A93-53292 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE VIOLENT ENVIRONMENT OF THE ORIGIN OF LIFE - PROGRESS AND UNCERTAINTIES
CHRISTOPHER F. CHYBA (NASA, Ames Research Center, Moffett Field, CA) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3351-3358. Geological Society of America, Geochemical Society, and AChS, Symposium on Survivability of Organic Matter at High Temperatures: Implications for Life, San Diego, CA, Oct. 20, 1991 Research supported by National Research Council and NASA refs
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Dating of terrestrial fossils and returned lunar samples reveals that the origin of life on Earth occurred not in a quiescent, peaceful environment, but rather in a violent, impact-ridden one. This realization has important consequences. On the one hand, sufficiently large and fast impactors can erode planetary atmospheres, and the very largest of these may have sterilized the surface of the Earth. In this regard, deep-sea hydrothermal vents become especially interesting for the history of early life, as they provide an environment protected against all but the greatest impact devastation. At the same time, impactors would have been delivering key biogenic elements (such as carbon and nitrogen) to Earth's surface, and (with much greater difficulty) intact organic molecules as well. Estimates of the various sources of prebiotic organics suggest that the heavy bombardment either produced or delivered quantities of organics comparable to those produced by other energy sources. However, substantial uncertainties exist. After reviewing the current understanding of the role of the heavy bombardment in the origins of life, a number of remaining key uncertainties are considered, and attempts are made to both quantify their magnitude and point to means of resolving them.

A93-53294* National Aeronautics and Space Administration, Washington, DC.
COMMENT ON 'SUMMARY AND IMPLICATIONS OF REPORTED AMINO ACID CONCENTRATIONS IN THE MURCHISON METEORITE' BY E. L. SHOCK AND M. D. SCHULTE
STANLEY L. MILLER (California Univ., La Jolla) and JEFFREY L. BADA (Scripps Institution of Oceanography, La Jolla, CA) Geochimica et Cosmochimica Acta (ISSN 0016-7037) vol. 57, no. 14 July 1993 p. 3473, 3474; Authors' Reply, p. 3475-3477. Research supported by NASA refs
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A criticism of the claim by Shock and Schulte (1990) that there is a correlation between the amino acid abundances (relative to glycine) in the Murchison meteorite and their aqueous solubilities is presented. Their suggestion that 'the same factors which control the aqueous solubility of many amino acids also control their relative abundances in the Murchison meteorite is argued to be incorrect. It is proposed that even though the water/meteorite ratio would have been less during meteorite aqueous alteration than that in the 100-C laboratory extraction procedure, amino acids are simply too soluble. The distribution of other meteorite organic components such as PAHs may have been affected by alteration because they are only slightly soluble in water and can be easily separated by geochromatographic processes. In their reply Shock and Schulte contend that the critics argue against a point not made in their paper and that their argument was supported with several unsubstantiated assertions, including an unfounded claim that the temperature dependence of amino acid solubilities are 'not greatly different', a misrepresentation of isopiestic studies on concentration solutions as equilibrium solubility measurements. AIAA

A93-55997* National Aeronautics and Space Administration, Washington, DC.
CARBONACEOUS CHONDRITES AND THE ORIGIN OF LIFE
HYMAN HARTMAN (California Univ., Berkeley), MICHAEL A. SWEENEY, MICHAEL A. KROPP (Santa Clara Univ., CA), and JOHN S. LEWIS (Arizona Univ., Tucson) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 4 Aug. 1993 p. 221-227. refs
(Contract NAGW-114)
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Organic matter in carbonaceous chondrites can be separated into three fractions. The first component, the fraction that is insoluble in chloroform and methanol, has a part which is of interstellar origin. The other two fractions (chloroform-soluble hydrocarbons and methanol-soluble polar organics) are hypothesized to have been synthesized on a planetoid body. We propose that the polar organics, i.e., amino acids, were synthesized close to its surface by the radiolysis of hydrocarbons and ammonium carbonate in a liquid water environment. Some hydrocarbons may have been synthesized by a Fischer-Tropsch mechanism in the interior of the body. Ferrous ion acted as a protection against back reactions. The simultaneous synthesis of iron-rich clays with the polar organics may be indicative of events related to the origin of life on Earth. Author (revised)

A93-55998* National Aeronautics and Space Administration, Washington, DC.
OLIGOMERIZATION REACTIONS OF RIBONUCLEOTIDES - THE REACTION OF THE 5'-PHOSPHORIMIDAZOLIDE OF ADENOSINE WITH DIADENOSINE PYROPHOSPHATE ON MONTMORILLONITE AND OTHER MINERALS
JAMES P. FERRIS and GOZEN ERTEM (Rensselaer Polytechnic Inst., Troy, NY) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 4 Aug. 1993 p. 229-241. refs
(Contract NSF CHE-85-06377; NGR-03-018-148)
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The overall regiospecificity of the 3',5'-phosphodiester bond formation is shown to be increased from 64 to 83 percent when a 9:1 ratio of ImpA to A5'ppA instead of ImpA alone is reacted in the presence of Na(+)-montmorillonite. The major factor in the regiospecificity increase is the formation of 3',5'-linked A5'ppA3'pA and A5'pp-A3'pA3'pA. The results obtained show that ImpA reacts more readily with A5'ppA than it does with another ImpA molecule and that A5'ppA plays a central role in directing the formation of 3',5'-phosphodiester bonds. AIAA

A93-56000
A MODEL FOR THE PREBIOTIC SYNTHESIS OF PEPTIDES WHICH THROWS LIGHT ON THE ORIGIN OF THE GENETIC CODE AND THE OBSERVED CHIRALITY OF LIFE
A. R. MELLERSH (Derby City Hospital, United Kingdom) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 4 Aug. 1993 p. 261-274. refs
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A model is proposed which indicates that peptides could have been synthesized on RNA templates. L-amino acids are selectively trapped and orientated in clefts in an apparently stable RNA structure attached to a solid phase. Each cleft is bounded by three bases which correspond to the codon for that amino acid. Rotation during a dehydration phase orientates the amino acids so that peptide bond formation can occur by condensation. Rehydration releases the formed peptides.

AEROSPACE MEDICINE AND BIOLOGY / *A Continuing Bibliography (Supplement 383)* January 1994

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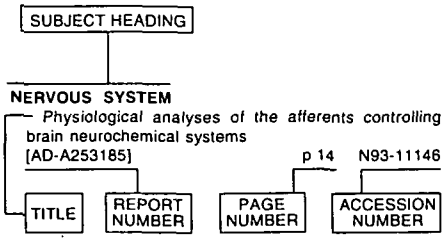

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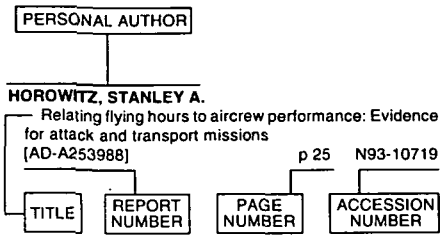

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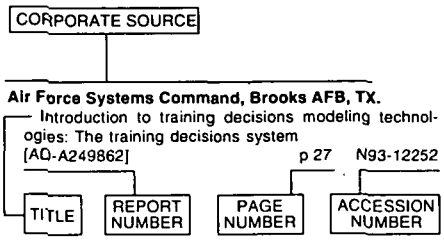

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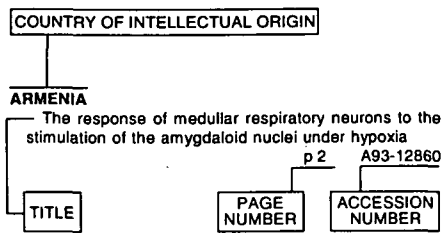

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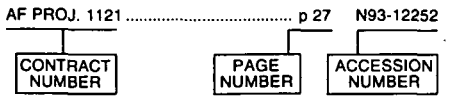

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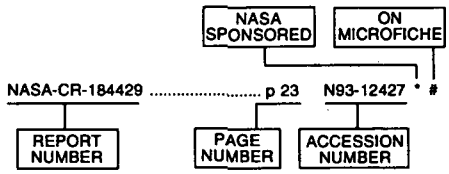

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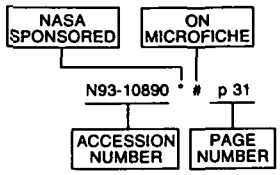

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