NASA SP-7011 (364)
July 1992

P-71

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

NASA STI PROGRAM
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NASA SP-7011 (364)
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National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC 1992

INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 188 reports, articles and other documents originally announced in June 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).* The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-20046 — N92-22095
IAA (A-10000 Series)	A92-28555 — A92-32534

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

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

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

A cumulative index for 1992 will be published in early 1993.

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

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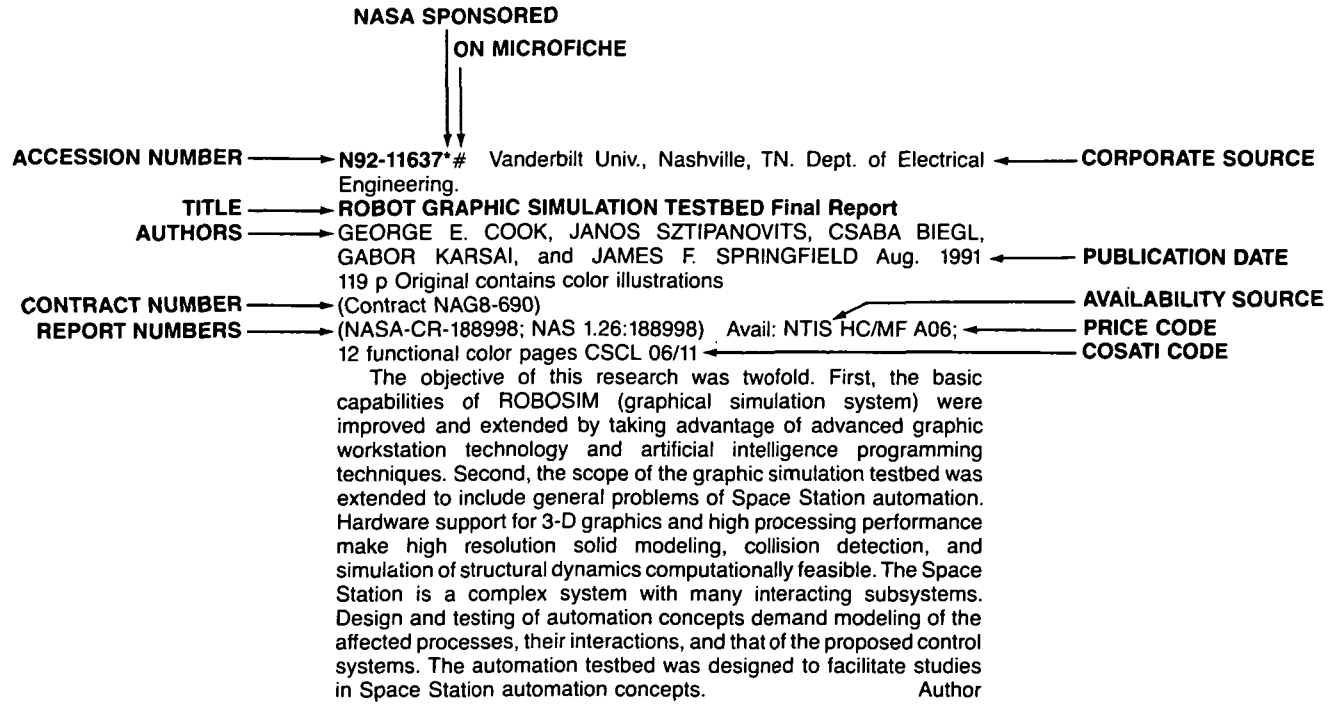
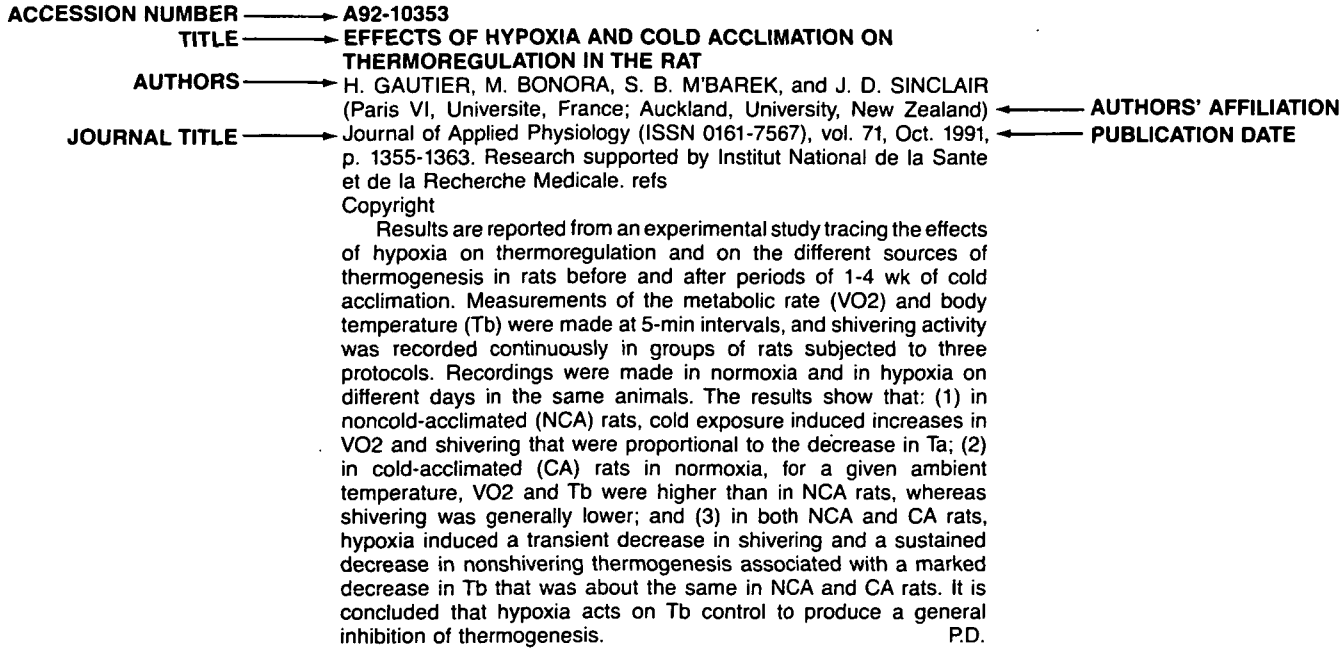
TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 364)

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LIFE SCIENCES (GENERAL)

A92-28998
END OF THE PROTEROZOIC EON
ANDREW H. KNOLL (Harvard University, Cambridge, MA) Scientific American (ISSN 0036-8733), vol. 265, Oct. 1991, p. 64-67, 70-73. refs
Copyright

It is argued that at the end of the Proterozoic eon a net production of oxygen occurred when organic remains from photosynthetic organisms were buried in sediments and not respired back to CO2 and water by nonphotosynthetic organisms. Some of this buried oxygen found its way to the atmosphere, and atmospheric oxygen eventually accumulated to the point when it fueled the rapid evolution of multicellular animals. C.D.

A92-30276
THE EFFECT OF EXOGENIC HEPARIN ON THE SECRETORY ACTIVITY OF MAST CELLS OF RATS SUBJECTED TO IMMOBILIZATION STRESS [VLIIANIE EKZOGENNOGO GEPARINA NA SEKRETORNYI STATUS TUCHNYKH KLETOK KRYSY PRI IMMOBILIZATSIONNOM STRESSE]
F. B. SHAPIRO, B. A. UMAROVA, T. N. DUGINA, and S. M. STRUKOVA (Moskovskii Gosudarstvennyi Universitet, Moscow, Russia) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 37, Sept.-Oct. 1991, p. 11-16. In Russian. refs
Copyright

A92-30279
PROTECTIVE ACTIVITY OF MALONIC ACID DURING HYPOXIC HYPOXIA [ZASHCHITNOE DEISTVIE MALONOVOI KISLOTY PRI GIPOKSICHESKOI GIPOKSII]
V. V. DAVYDOV and A. V. REPETSKAIA (Zaporozhskii Meditsinskii Institut, Zaporozhe, Ukraine) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 37, Sept.-Oct. 1991, p. 111, 112. In Russian. refs
Copyright

The effect of malonic acid injections on the resistance of an organism to acute hypoxia was investigated in rats subjected for up to 60 min to a simulated altitude of 12,000 m. It was found that injections of 10 to 100 mg malonic acid per 200 g body weight significantly increased the number of rats surviving 30 min exposures and prolonged the time of survival of rats receiving 100 mg malonic acid/200 kg body weight. I.S.

A92-30410
AN ELECTROPHYSIOLOGICAL INVESTIGATION OF THE BRAINS OF RATS WITH DIFFERENT RESISTANCES TO OXYGEN DEFICIENCY UNDER CONDITIONS OF ACUTE HYPOXIA [ELEKTROFIZIOLOGICHESKOE ISSLEDOVANIE MOZGA KRYS S RAZNOI USTOICHIVOST'IU K KISLORODNOI NEDOSTATOCHNOSTI V USLOVIIAKH OSTROI GIPOKSII]
S. V. KRAPIVIN, V. E. ROMANOVA, T. A. VORONINA, and L. D. LUK'IANOVA (AMN SSSR, Institut Farmakologii, Moscow, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 77, July 1991, p. 1-6. In Russian. refs
Copyright

Results are presented from an investigation of the EEG power spectra of the cerebral cortex, hippocampus, and hypothalamus of rats with either low or high resistances to oxygen deficiency, taken before and after the rats were exposed to a simulated altitude of 11,000 m. It was found that the low-resistant rats that were exposed to the high-altitude conditions for 2 min displayed changes in the magnitude of the dominant peak of EEG spectra, whereas the EEG spectra of highly resistant rats remained unchanged. I.S.

A92-31331* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT AND (EVIDENCE FOR) DESTRUCTION OF BIOFILM WITH PSEUDOMONAS AERUGINOSA AS ARCHITECT
VALERIE N. UZCATEGUI, JOHN J. DONADEO, DANIEL R. LOMBARDI, MICHAEL J. COSTELLO (New York, State University, Binghamton), and RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 45-60. refs
(Contract NAG9-307)
(SAE PAPER 911404) Copyright

Disinfection and maintenance of an acceptable level of asepsis in spacecraft potable water delivery systems is a formidable task. The major area of research for this project has been to monitor the formation and growth of biofilm, and biofilm attached microorganisms, on stainless steel surfaces (specifically coupons), and the use of ozone for the elimination of these species in a closed loop system. A number of different techniques have been utilized during the course of a typical run. Scraping and sonication of coupon surfaces with subsequent plating as well as epifluorescence microscopy have been utilized to enumerate biofilm protected Pseudomonas aeruginosa. In addition, scanning electron microscopy is the method of choice to examine the integrity of the biofilm. For ozone determinations, the indigo decolorization spectrophotometric method seems most reliable. Both high- and low-nutrient cultured P. aeruginosa organisms were the target species for the ozone disinfection experiments. Author

N92-20215# Office of Technology Assessment, Washington, DC.
BIOTECHNOLOGY IN A GLOBAL ECONOMY
Oct. 1991 293 p
(PB92-115823; OTA-BA-494; ISBN-0-16-035541-9) Avail: NTIS HC/MF A13; also available SOD HC $13.00 as 052-003-01258-8 CSCL 06C

The impact is examined of biotechnology in several industries, including pharmaceuticals, chemicals, agriculture, and hazardous waste clean up. The efforts of 16 Nations to develop commercial uses of biotechnology is also examined along with the actions, both direct and indirect, taken by various governments that influence innovation in biotechnology. Author

N92-20422*# Georgia State Univ., Atlanta.
HUMAN BEHAVIOR AND HUMAN PERFORMANCE: PSYCHOMOTOR DEMANDS Semiannual Status Report, Sep. 1991 - Feb. 1992
Feb. 1992 9 p
(Contract NAG2-438)
(NASA-CR-190112; NAS 1.26:190112) Avail: NTIS HC/MF A02 CSCL 06A

The results of several experiments are presented in abstract form. These studies are critical for the interpretation and acceptance of flight based science to be conducted by the Behavior and Performance project. Some representative titles are as follow: External audio for IBM/PC compatible computers; A comparative assessment of psychomotor performance (target prediction by humans and macaques); Response path (a dependent measure for computer maze solving and other tasks); Behavioral asymmetries of psychomotor performance in Rhesus monkey (a dissociation between hand preference and skill); Testing primates with joystick based automated apparatus; and Environmental enrichment and performance assessment for ground or flight based research with primates; Author

N92-20453# Virginia Commonwealth Univ., Richmond. Dept. of Physiology.
EFFECTS OF 27 MHZ RADIATION ON SOMATIC AND GERM CELLS Report, 27 Sep. 1985 - 29 Sep. 1990
S. F. CLEARY 18 Jan. 1991 11 p
(Contract NIOSH-R01-OH-02148)
(PB92-124007) Avail: NTIS HC/MF A03 CSCL 06C

A study was made of the dose dependence of effects of 27 and 2450 MHz continuous wave (CW) and pulse modulated (PM) radiation exposure of normal resting peripheral human lymphocytes, human glioma (LN71), HeLa, and Chinese-hamster-ovary (CHO) cells. Direct radiation effects on mouse germ cells were also studied. Effects of high frequency electromagnetic radiation (EMR) on lymphocyte and glioma mitogenesis and the CHO cell cycle in-vitro provide evidence of direct dose or dose rate dependent alteration of a highly physiologically significant cellular endpoint. Although in-vitro data cannot be extrapolated directly to in-vivo responses, the experimental conditions of these in-vitro studies suggest that qualitatively similar effects may be induced by in-vivo exposure to electromagnetic fields of these frequencies. It is concluded that physiologically significant cellular alterations are induced by 27 and 2450 MHz CW and PM radiation exposure under conditions that do not involve heating. It is suggested that the adequacy of radio frequency occupational exposure guidelines that suggest the health effects are attributable to radiation induced tissue heating must be questioned. Author

N92-20704# Kansas Univ., Lawrence. Center for Biomedical Research.
GLUTAMATE/NMDA RECEPTOR ION-CHANNEL PURIFICATION, MOLECULAR STUDIES, AND RECONSTITUTION INTO STABLE MATRICES Final Report, 15 Mar. 1988 - 1 Jul. 1991
ELIAS K. MICHAELIS 29 Aug. 1991 6 p
(Contract DAAL03-88-K-0017)
(AD-A244727; ARO-25702.1-LS) Avail: NTIS HC/MF A02 CSCL 06/5

This is the final report of a project that had as its primary focus the isolation of the NMDA receptor protein complex and the reconstitution of these proteins for the development of biosensors. The progress made in all phases of this work has met the goals selected for the research. (1) Two proteins of the receptor were fully purified and characterized. (2) The intact complex was purified and biochemically characterized. (3) One of the protein DNA's was cloned and sequenced. (4) The complex was reconstituted into liposomes and planar lipid bilayers. (5) A prototype sensor based on this receptor complex was developed. (6) Cell model systems for the study of the receptor were developed. GRA

N92-20813# Pathology Associates, Inc., Frederick, MD.
ANIMAL MODELS OF IONIZING RADIATION DAMAGE Technical Report, 18 May 1988 - 18 May 1991
LYNDA L. PIPPIN 1 Jan. 1992 316 p
(Contract DNA001-88-C-0120; DA PROJ. R99-QAXE)
(AD-A245268; DNA-TR-91-111) Avail: NTIS HC/MF A14 CSCL 06/7

This report is a survey of the English language literature of radiation biology between 1947 and 1987, for the purpose of compiling a literature base on the effects of radiation on animals, which have yielded results that can expand our knowledge about similar radiation effects on human beings. Articles were sought that reported exposure of adult mammals to external sources of ionizing radiation, having endpoints that included effects on the brain, the spinal cord, and behavior, the gastrointestinal, endocrine, and cardiovascular systems, and the hematopoietic and immune systems. Effects of interest were those that occurred within the first 12 months after exposure. The survey does not include articles reporting chronic or long term delayed effects of radiation unless they provided insight into mechanisms of morphological and/or functional derangement. Information presented in the report is divided into subtopics (i.e., Brain-Morphological Changes). The brief introduction to each subtopic is followed by a condensed description of representative reports and a short summary of conclusions based on those reports. The articles reviewed are appended as a Bibliography, arranged alphabetically within subtopics. GRA

N92-21044# California Univ., Berkeley. Dept. of Plant Biology.
PHYTOCHROME FROM GREEN PLANTS: ASSAY, PURIFICATION, AND CHARACTERIZATION
P. H. QUAIL 10 Jun. 1991 17 p Prepared in cooperation with Agricultural Research Service, Albany, CA
(Contract DE-FG03-87ER-13742)
(DE92-003396; DOE/ER-13742/5) Avail: NTIS HC/MF A03

This funding period was directed at developing an in-depth molecular analysis of the low-abundance, 118,000 M(sub r) green-tissue phytochrome that had at that time been relatively recently identified as being distinct from the better characterized 124,000 M(sub r) phytochrome abundant in etiolated tissue. The specific objectives as stated in the original proposal were: (1) to generate monoclonal antibodies specific to the 118,000 M(sub r) green-tissue phytochrome; (2) to develop additional and improved procedures to permit progress toward the ultimate goal of purifying green-tissue phytochrome to homogeneity; (3) to initiate an alternative approach to determining the structural properties of green-tissue phytochrome by isolating and sequencing cDNA clones representing the 118,000 M(sub r) green-tissue polypeptide in Avena (this approach is based on and will test hypothesis that the 118,000 M(sub r) polypeptide is encoded by a gene(s) distinct from those encoding etiolated-tissue 124,000 M(sub r) phytochrome); (4) to utilize any such 118,000 M(sub r) phytochrome specific cDNA clones as hybridization probes to begin to investigate the structure, organization, and regulation of the corresponding gene(s) in Avena; and (5) to begin to investigate the possible presence in other higher plant and algal species of sequences homologous to the 118,000 M(sub r) Avena polypeptide using the Avena clones at hybridization probes. Most of these objectives have been accomplished, at least in principle, although the major breakthrough establishing that phytochrome is encoded by a multigene family came from the use of Arabidopsis rather than Avena. Similarly, much of the characterization subsequent to this discovery has been performed in Arabidopsis and rise as model dicot and monocot systems, respectively, rather than Avena. DOE

N92-21328# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
INHALATION TOXICOLOGY. 12: COMPARISON OF TOXICITY RANKINGS OF SIX POLYMERS BY LETHALITY AND BY INCAPACITATION IN RATS Final Report
DONALD C. SANDERS, BOYD R. ENDECOTT, and ARVIND K.

CHATURVEDI Dec. 1991 10 p
(AD-A244599; DOT/FAA/AM-91/17) Avail: NTIS HC/MF A02
CSCL 06/11

Polymeric aircraft cabin materials have the potential to produce toxic gases in fires. Lethality (LC50) in animal models is a standard index to rank polymers on the basis of their combustion product toxicity. However, the use of times-to-incapacitation (t sub i s) may be more realistic for predicting relative escape times from a fire environment. Therefore, LC50's and t sub i s for six pure polymers of different chemical classes were determined and compared. The polymers were polyamide, polystyrene, Nylon 6/6, polysulfone, polyethylene, and chlorinated polyethylene. In the study, male Sprague-Dawley rats (150-250 g), 12 animals per fuel loading, were exposed to the pyrolysis products from selected weights of each polymer for 30 min in a 265-L combustion exposure system, and LC50s were determined following a 14-day observation period. GRA

N92-21331# Yale Univ., New Haven, CT.
CONTROL OF BIODEGRADATION IN BACTERIA Final Report, 15 Jul. 1988 - 14 Jul. 1991
L. N. ORNSTON 26 Aug. 1991 8 p
(Contract DAAL03-88-K-0074)
(AD-A244818; ARO-25493.13-LS) Avail: NTIS HC/MF A02
CSCL 06/5

Analysis of genes for the Beta-ketoadipate pathway revealed mechanisms underlying evolutionary divergence of controls governing biodegradation in bacteria. Transcriptional regulators that respond to muconate in Acinetobacter calcoaceticus and Pseudomonas putida diverged recently from a common ancestor. This divergence produced the A. calcoaceticus catM repressor gene and the P. putida activator catR gene. Thus, a single ancestor gave rise to one gene that exercises negative control and another gene that exerts positive control over transcription. Independently transcribed genes for related physiological functions are clustered in the A calcoaceticus chromosome, and the evolutionary basis for selection of this supraoperonic clustering is unknown. Advances in the genetics of this organism will make it possible to explore the genetic and physiological consequences of engineered transpositions which alter the structure of supraoperonic clusters. GRA

N92-21376*# San Jose State Univ., CA. Dept. of Biological Sciences.
COSMOS 2044. EXPERIMENT K-7-19. PINEAL PHYSIOLOGY IN MICROGRAVITY: RELATION TO RAT GONADAL FUNCTION Final Report
D. HOLLEY, M. R. I. SOLIMAN, I. KRASNOV (Institute of Biomedical Problems, Moscow, USSR), and H. ASADI 1989 18 p
(Contract NAG2-594)
(NASA-CR-190066; NAS 1.26:190066) Avail: NTIS HC/MF A03
CSCL 06/1

It is now known that the pineal organ can interact with many endocrine and nonendocrine tissues in a regulatory fashion. Given its key role in the regulation of melatonin synthesis, its high concentration, and that its levels may persist longer than the more rapidly changing melatonin, it was felt that serotonin might give a more accurate assessment of the effects of microgravity on pineal function following recovery of animals from flight. Five-hydroxyindole acetic acid (5-HIAA), a major metabolite of serotonin metabolism, was also measured. One of the most interesting concomitants to spaceflight and exposure to microgravity has been the disturbing alteration in calcium metabolism and resulting skeletal effects. Given the link between exposure to microgravity and perturbation of calcium metabolism and the fact that the pineal is apparently one of the only soft tissues to calcify, pineal calcium content was examined following spaceflight. Author

N92-21396# Los Alamos National Lab., NM.
ROLES OF REPETITIVE SEQUENCES
G. I. BELL 1991 28 p Presented at the Workshop on Open Problems in Computational Molecular Biology, Telluride, CO, 2-8 Jun. 1991
(Contract W-7405-ENG-36)
(DE92-004858; LA-UR-91-4129; CONF-9106319-1) Avail: NTIS HC/MF A03

The DNA of higher eukaryotes contains many repetitive sequences. The study of repetitive sequences is important, not only because many have important biological functions, but also because they provide information on genome organization, evolution and dynamics. In this paper, I will first discuss some generic effects that repetitive sequences will have upon genome dynamics and evolution. In particular, it will be shown that repetitive sequences foster recombination among, and turnover of, the elements of a genome. I will then consider some examples of repetitive sequences, notably minisatellite sequences and telomere sequences as examples of tandem repeats, with and without known function, and Alu sequences as an example of interspersed repeats. Some other examples will also be considered in less detail. DOE

N92-21718# Office of Naval Research, Arlington, VA.
BIOLOGICAL SCIENCES DIVISION 1991 PROGRAMS Summary Report, 1 Oct. 1990 - 30 Sep. 1991
ERIC EISENSTADT Aug. 1991 413 p
(AD-A244800; OCNR-11491-23) Avail: NTIS HC/MF A18
CSCL 07/3

This report documents R and D performed by Principal Investigators under the sponsorship of the ONR Biological Sciences Division during fiscal year 1991. This report includes the following topics: biocatalysis in non aqueous solvents, biodeterioration, biomimetics, biopolymeric materials, education, high temperature, pressure biology, marine symbiosis, marine viruses, molecular biology, marine organisms, water biological interfaces, immunophysiology, cell biology, pressure biology, sensory biophysics, membrane biology I, membrane biology, an single neuron computation. GRA

N92-21786# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
NON-INVASIVE FUNCTIONAL LOCALIZATION BY BIOMAGNETIC METHODS
J. NENONEN and T. KATILA Jan. 1991 54 p
(PB92-134121; TKK-F-A676; ISBN-951-22-0506-8) Avail: NTIS HC/MF A04 CSCL 06/1

Noninvasive biomagnetic measurements are feasible for obtaining functional information concerning the electrical activity of various organs, e.g., the human heart and brain. These methods are completely noninvasive, and they have turned out to be promising in localizing various bioelectric sources in the body. During the last years, the number of localization studies reported has increased rapidly. Although the methods are not clinically accepted as yet, possible clinical applications would be numerous; for example, the localization of various cortical sources and epileptic foci in the brain, as well as the localization of arrhythmogenic tissue and both normal and abnormal conduction pathways between the atria and the ventricles in the heart. The best localization accuracies reported in brain studies are of the order of few millimeters, and in heart studies about 1 to 2 cm. These accuracies would be good enough to be useful in presurgical localization of regions of interest, but still more clinical studies are needed to evaluate the efficacy and validity of the methods. Author

N92-22024* Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 32
LYDIA RAZRAN STONE, ed. and JOSEPH ROWE, ed. (Library of Congress, Washington, DC.) Washington NASA Jan. 1992 86 p
(Contract NASW-4292)
(NASA-CR-3922(38); NAS 1.26:3922(38)) Avail: NTIS HC A05
CSCL 06/3

This is the thirty-second issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 34 journal or conference

papers published in Russian and of 4 Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. The abstracts in this issue have been identified as relevant to 18 areas of space biology and medicine. These areas include: adaptation, aviation medicine, biological rhythms, biospherics, cardiovascular and respiratory systems, developmental biology, exobiology, habitability and environmental effects, human performance, hematology, mathematical models, metabolism, microbiology, musculoskeletal system, neurophysiology, operational medicine, and reproductive system. Author

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AEROSPACE MEDICINE

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

A92-29548
A STUDY ON PILOT WORKLOAD - A BASIC APPROACH TO QUANTIFY PILOT'S WORKLOAD FROM POWERS DATA
ZOJIRO KATOH, ATUSHI KADOO, SHUUJI NISHI, YOSHINORI TAKEUCHI, YUKO NAGASAWA, and KENJI MATUHISA Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 1-14. In Japanese. refs

A basic approach to quantifying a pilot's workload is presented using POWERS (Pilot's Operational Workload Evaluation Research Simulator). POWERS data are composed of pilots' manipulation of controls and switches, as well as electrophysiological and flight parameter data. Data on the timing, duration, frequency, and amount of continuous and discrete manipulation of control and switches by the pilot lead to an analysis of the manipulation characteristics and complexity. Data from ECG, EOG, EEG, EMG, and respiration lead to predictions of workload index. Flight performance parameters are used to extract variables which contribute to subjective difficulty ratings. C.D.

A92-29550
AUTOMATIC BLOOD SAMPLING SYSTEM
YOSHINORI MIYAMOTO, HIDEAKI SHIMAZU, ATSUSHI KAWARADA, HIDEO TARUI, and HIROSHI ITO (Kyorin University School of Medicine, Mitaka, Japan) Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 23-27. In Japanese. refs

An automatic blood sampling system for use in collecting blood consecutively during Gz stress in a subject has been developed. The system consists of a catheter unit, microtube pump, main control, and manifold unit which contains eight collecting tubes. Blood is automatically pumped out and fed into the manifold. The volume of blood collected by the device is controlled by the length of time the main control switch is used. The system would be useful in sampling blood during Gz stress and/or other aviation stress. C.D.

A92-29994
HEMODYNAMIC AND HORMONAL EFFECTS OF PROLONGED ANTI-G SUIT INFLATION IN HUMANS
GHISLAINE GEELEN, PHILIPPE ARBEILLE, JEAN-LOUIS SAUMET, JEAN-MARIE COTTET-EMARD, FREDERIC PATAT, and MADELEINE VINCENT (Lyon I, Universite, Lyons; Tours, Universite; Angers, Universite, France) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, March 1992, p. 977-984. Research supported by Universite Lyon I, CNES, and DRET. refs
Copyright

The hemodynamic effects caused in humans by applying lower body positive pressure (LBPP) were examined together with the relationship between these effects and changes observed in blood-plasma concentrations of major vasoactive hormones. Results obtained on six human subjects showed that prolonged application of LBPP induces a transient increase in cardiac output and a marked and sustained decrease in blood-plasma activities of norepinephrine and renin, indicating an inflation-induced decrease in sympathetic activity. I.S.

A92-30277
CONTINUOUS NONINVASIVE MONITORING OF BLOOD CIRCULATION PARAMETERS DURING THE VALSALVA TEST UNDER CONDITIONS OF ELEVATED AMBIENT PRESSURE [NEPRERYVNAIA NEINVAZIVNAIA REGISTRATSIIA PARAMETROV KROVOOBRASHCHENIIA VO VREMIA PROVEDENIIA PROBY VAL'SAL'VY PRI POVYSHENNOM DAVLENII OKRUZHAIUSHCHEI SREDY]
S. A. GULIAR, V. N. IL'IN, V. A. REBEN, A. L. EVTUSHENKO, and M. A. EPLER (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR; Tartuskii Gosudarstvennyi Universitet, Tartu, Estonia) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 37, Sept.-Oct. 1991, p. 36-41. In Russian. refs
Copyright

A92-30325
THEORETICAL ASSESSMENT OF THE RISK OF DECOMPRESSION SICKNESS IN THE CASE OF SINGLE-STAGE PRESSURE DROPS [TEORETICHESKAIA OTSENKA RISKA ZABOLEVANIIA DEKOMPRESSIONNOI BOLEZN'IU PRI ODNOSTUPENCHATYKH PEREPADAKH DAVLENIIA]
V. P. NIKOLAEV (Institut Mediko-Biologicheskikh Problem, Moscow, Russia) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 321, no. 6, 1991, p. 1291-1295. In Russian. refs
Copyright

The risk of decompression sickness in the case of single-stage pressure drops is evaluated on the basis of a mathematical model of the formation and growth of gas bubbles in the organism (i.e., the 'embolization' process). Curves showing the dependence of the risk of decompression sickness on the magnitude of pressure drop are plotted. It is suggested that the probability (with a confidence of 0.95) of decompression sickness in connection with EVA does not exceed 0.04. L.M.

A92-31307* National Aeronautics and Space Administration, Washington, DC.
MR IMAGING OF HAND MICROCIRCULATION AS A POTENTIAL TOOL FOR SPACE GLOVE TESTING AND DESIGN
STEVEN W. PETERSON, ALVIN M. STRAUSS, TRISTA A. NIEMANN, and CHRISTINE H. LORENZ (Vanderbilt University, Nashville, TN) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 61-65. Research supported by NASA. refs
(SAE PAPER 911382) Copyright

The task of evaluating and designing space gloves requires accurate biomechanical characterization of the hand. The availability of magnetic resonance (MR) imaging has created new opportunities for in vivo analysis of physiological phenomena such as the relationship between circulation and fatigue. An MR imaging technique originally proposed to quantitatively evaluate cerebral perfusion has been modified to evaluate the capillary microcirculation in hand muscles. An experimental protocol was developed to acquire perfusion-weighted images in the hand before and after various levels of exercise. Preliminary results on the feasibility of applying the MR imaging technique to the study of microcirculation and fatigue in the hand are presented. The potential of this method for space glove testing and design is also discussed. Author

A92-32455
HUMAN PHYSIOLOGY IN MICROGRAVITY - AN OVERVIEW
GUGLIELMO ANTONUTTO and PIETRO E. DI PRAMPERO (Udine, Universita, Italy) (Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings.

A92-32451 12-12) Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, p. 145-147. Copyright

In microgravity a thorough readjustment of several physiological functions takes place. As an example, the cardiovascular system adapts in a relatively short time to the new condition, leading to a persisting 'cardiovascular deconditioning' upon return on earth after long term space missions. Moreover, the prevention of the musculo-skeletal decay related associated with long term space flights still represents a problem. Both cardiovascular deconditioning and musculo-skeletal decay have been partially prevented during space flights by appropriate programs of physical exercise. A more successful prevention would be probably attained if exercise could be coupled with artificial gravity. A system is proposed consisting of two mechanically coupled counter rotating bicycles, moving on the inner wall of a cylindrical space module. The two pedalling subjects generate a centrifugal acceleration vector simulating gravity. By selecting appropriately the radial dimensions of the space module in order to minimize the vestibular disturbances, the head to feet centrifugal acceleration gradients and the manufacturing costs, it will be possible to combine exercise and simulated gravity, with no need for additional external power. Author

N92-20276*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MUSCLE ULTRASTRUCTURAL CHANGES FROM EXHAUSTIVE EXERCISE PERFORMED AFTER PROLONGED RESTRICTED ACTIVITY AND RETRAINING IN DOGS

K. NAZAR, J. E. GREENLEAF, D. PHILPOTT, E. POHOSKA, K. OLSZEWSKA, and H. KACIUBA-USCILKO (Polish Academy of Sciences, Warsaw.) Nov. 1991 25 p

(NASA-TM-103904; A-92018; NAS 1.15:103904) Avail: NTIS HC/MF A03 CSCL 06P

The effect of exhaustive treadmill exercise on ultrastructural changes in the quadriceps femoris muscle was studied in 7 normal, healthy dogs, before and after restricted activity (RA), and following a subsequent 2 month treadmill exercise retraining period for the 5 mo group. Mean time to exhaustion in the 2 mo group decreased from 177 + or - 22 min before to 90 + or - 32 min after RA. Retraining increased tolerance to 219 + or - 73 min; 24 pct. above the before RA and 143 pct. above the after RA time. After RA exhaustion time in the 5 mo group was 25 and 45 min. Before RA, pre-exercise muscle structure was normal and post exercise there was only slight swelling of mitochondria. After RA, pre-exercise, numerous glycogen granules and lipid droplets appeared in the muscle fibers, mitochondria were smaller, and sarcoplasmic reticulum channels widened; post exercise these changes were accentuated and some areas were devoid of glycogen, and there was fiber degradation. After 5 mo RA pre-exercise there were more pronounced changes; mitochondria were very small and dense, there were many lipid droplets, myofibrils were often separated, and the fibers appeared edematous and degenerating; post exercise the sarcoplasmic reticulum was swollen, no glycogen was present, and there was marked swelling and deformation of mitochondria. After retraining, both pre-exercise and post exercise there was still evidence of fiber degeneration. Thus, susceptibility of active skeletal muscle structures and subcellular elements, e.g., mitochondria, to the action of damaging factors occurring during exhaustive exercise is enhanced considerably by prolonged disuse. Author

N92-20440# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

BLOOD LACTATE RESPONSE TO THE CF EXPRES STEP TEST Final Report

D. G. BELL and I. JACOBS 18 Jun. 1991 19 p

(DCIEM-91-44; CTN-92-60450) Avail: NTIS HC/MF A03

This is the final report on the tasking to look at the blood lactate (LA) response to the Canadian Aerobic Fitness Test. The purposes of the study were to determine if LA could be used to predict maximal aerobic power from the EXPRES step-test procedures and to compare the prediction with the current procedures which employ submaximal heart rate (HR). Male and female Canadian Forces personnel between the ages of 18 and 53 years participated in the study. The LA concentration after each stage of the step test was measured in all subjects by sampling blood from the fingertip. A sub-sample of the population had their maximal aerobic power measured directly during a maximal treadmill run. LA and HR from stage 5 of the step-test were correlated with the treadmill determined maximal aerobic power. The results showed increasing stages of the step test were associated with increasing LA. Correlations between LA and maximal aerobic power were -0.71 and -0.72 for the males and females, respectively, and were higher than the correlations between HR and the maximal aerobic power which were -0.36 and -0.65 respectively. Age appears to be the main difference in LA response between males and females. Author (CISTI)

N92-20668*# MCAT Inst., San Jose, CA.

INCOMPRESSIBLE VISCOUS FLOW COMPUTATIONS FOR THE PUMP COMPONENTS AND THE ARTIFICIAL HEART Final Report

CETIN KIRIS Mar. 1992 13 p Original contains color illustrations

(Contract NCC2-500)

(NASA-CR-190076; NAS 1.26:190076; MCAT-92-003) Avail: NTIS HC/MF A03; 1 functional color page CSCL 06C

A finite difference, three dimensional incompressible Navier-Stokes formulation to calculate the flow through turbopump components is utilized. The solution method is based on the pseudo compressibility approach and uses an implicit upwind differencing scheme together with the Gauss-Seidel line relaxation method. Both steady and unsteady flow calculations can be performed using the current algorithm. Here, equations are solved in steadily rotating reference frames by using the steady state formulation in order to simulate the flow through a turbopump inducer. Eddy viscosity is computed by using an algebraic mixing-length turbulence model. Numerical results are compared with experimental measurements and a good agreement is found between the two. Author

N92-20709# Colorado Univ., Boulder. Cardiovascular Pulmonary Research Lab.

HUMAN ADAPTATION TO THE TIBETAN PLATEAU Final Report, 7 Aug. 1987 - 30 Jun. 1991

LORNA G. MOORE 12 Aug. 1991 79 p

(Contract DAMD17-87-C-7202; DA PROJ. 3M1-62787-A-879)

(AD-A244872) Avail: NTIS HC/MF A05 CSCL 06/5

Humans have lived at high altitude for longer periods of time on the Tibetan Plateau than elsewhere in the world, thus providing the opportunity to investigate the physiologic effects of long-term (years to generation) duration of high altitude exposure. This has military importance because persons are stationed at high altitudes for extended periods of time and experience marked decrements in performance and health. Knowledge as to the physiologic traits required for successful high-altitude adjustment is important for the selection of personnel resistant to the ill effects of high altitude and for the treatment of afflicted individuals. The results of this research supported the underlying hypothesis that Tibetans are better-adapted to high altitude than acclimatized newcomers in Tibet or than persons elsewhere in the world as judged from literature reports. The Tibetans' superiority was evidenced by greater maximal oxygen uptake, higher work capacity, increased greater vital capacity and lung volume, decreased alveolar-arterial oxygen diffusion gradient, absence of hypoxic pulmonary vasoconstriction, increased cardiac output and increased tissue oxygen utilization. In addition, Tibetans are resistant to the development of Chronic Mountain Sickness. Compared to healthy controls, persons with Chronic Mountain Sickness breathe less and have lower arterial oxygen saturations than healthy persons, due to the absence of hypoxic ventilatory sensitivity and greater hypoxic ventilatory depression, and likely suffer from decrements in nocturnal brain oxygen delivery. GRA

N92-20987# Pacific Northwest Lab., Richland, WA.
INTERACTION OF EXTREMELY-LOW-FREQUENCY ELECTROMAGNETIC FIELDS WITH LIVING SYSTEMS
T. S. TENFORDE Nov. 1991 6 p Presented at the International Conference on Advances in Power Systems Control, Operation and Management, Hong Kong (China), 5-8 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006478; PNL-SA-19554; CONF-9111177-1) Avail: NTIS HC/MF A02

The sources and physical properties of extremely-low-frequency (ELF) electromagnetic fields are described. Biological effects and mechanisms through which ELF fields interact with humans and other organisms are discussed, including several aspects of this subject that are presently under active laboratory investigation. Studies on the potential health effects of ELF fields present in the home and workplace are also summarized, including a critical evaluation of evidence for a possible linkage between exposure to ELF fields and cancer risk. DOE

N92-21008# Food and Drug Administration, Rockville, MD. Office of Science and Technology.
PREVIEW OF MAGNETOENCEPHALOGRAPHY (MEG)
May 1991 57 p
(PB92-111632) Avail: NTIS HC/MF A04 CSCL 06/16

The Division of Life Sciences within the Office of Science and Technology is responsible for the evaluation of biological information relevant to medical devices and radiological health. As part of the medical device effort, the Health Sciences Branch of the Division of Life Sciences has undertaken a general review of magnetoencephalography (MEG). MEG is a developing technology, based upon superconducting quantum interference devices (SQUIDs), which attempts to record and then analyze the magnetic fields generated by neural activity within the brain. MEG is a noninvasive technique like the traditional electroencephalography (EEG), but potentially offers an increased precision in the diagnostic analysis of brain function. The purpose of the document is to review the history, research, and current status of MEG as an emerging technology for the noninvasive analysis of normal and abnormal brain function in humans. GRA

N92-21009# Office of Technology Assessment, Washington, DC.
BIOLOGICAL RHYTHMS: IMPLICATIONS FOR THE WORKER. NEW DEVELOPMENTS IN NEUROSCIENCE
Sep. 1991 259 p
(PB92-117589; OTA-BA-463; ISBN-0-16-035497-8) Avail: NTIS HC/MF A12; also available SOD HC $11.00 as 052-003-01254-5 CSCL 06/16

An assessment of new developments in neuroscience is conducted. The report discusses biological rhythms: what they are, how they are controlled by the brain, and the role they play in regulating physiological and cognitive functions. The major focus of the report is the examination of the effects of nonstandard work hours on biological rhythms and how these effects can interact with other factors to affect the health, performance, and safety of workers. In addition, the report describes the Federal regulatory framework related to work hours and the current status of biological rhythm and shift work research. The report presents a range of options for congressional action related to the amount of research being conducted on these topics, the collection of relevant workplace statistical data, and the congressional role in ensuring the well-being of individuals engaged in nonstandard hours of work. GRA

N92-21021# School of Aerospace Medicine, Brooks AFB, TX.
FIELD STUDY EVALUATION OF AN EXPERIMENTAL PHYSICAL FITNESS PROGRAM FOR USAF FIREFIGHTERS Final Report, Jun. 1985 - Sep. 1986
L. G. MYHRE, W. GRIMM, G. R. VAN KIRK, R. TATTERSFIELD, and E. T. SHERRILL May 1991 30 p
(AD-A244498; AFESC/ESL-TR-90-22) Avail: NTIS HC/MF A03 CSCL 05/9

Under emergency conditions, firefighting demands extraordinary levels of physical effort in performing tasks under some of the most life threatening conditions. Success in performing these tasks depends on the firefighters physical fitness, particularly his/her cardiovascular endurance. Studies have shown that firefighters, both in the civilian and military sectors, are generally less fit than their age-related sedentary American counterparts. This report describes a field study to evaluate the safety and effectiveness of an experimental physical conditioning program that could be prescribed on an individual basis. Special emphasis was placed on a conservative program for older, less fit firefighters who would be most susceptible to exercise-related injury. GRA

N92-21186# Norwegian Defence Research Establishment, Kjeller. Forsvarets Forskningsinstitutt.
AMINO ACID NEUROTRANSMITTERS; MECHANISMS OF THEIR UPTAKE INTO SYNAPTIC VESICLES
ELSE MARIE FYKSE Aug. 1991 61 p
(NDRE/PUBL-91/1003; ISSN-0800-4412) Avail: NTIS HC/MF A04

It was shown that gamma-aminobutyric acid (GABA) and L-glutamate (later termed glutamate) were taken up by a Mg(++) and adenosine triphosphate (ATP) dependent mechanism into synaptic vesicles isolated in the rat brain. The vesicular uptake differed clearly from the synaptosomal and glial cell uptake, both with respect to Na(+), Mg(++), and ATP dependency. The uptake of glutamate and GABA was inhibited by similar, but not identical concentrations of different ionophores and by inhibitors of the Mg(++)-ATPase. The uptake of glutamate was dependent on the presence of low concentrations of Cl(-) or Br(-) in the incubation medium, whereas the uptake of GABA was not. In addition, the uptake of glutamate was more potently inhibited by blockers of Cl(-) exchange than the uptake of GABA. The results indicate involvement of a Cl(-) exchanger in the uptake of glutamate. The regional distribution in the brain of the uptake of GABA and glutamate was found to be different. The substrate specificity of the uptake of GABA and glycine was similar, and the vesicular uptake of GABA and glycine was competitively inhibited by different structure analogues. The results support the concept that synaptic vesicles are important for storage of amino acids in the nerve terminal. The mechanisms of the uptake of glutamate and GABA are different, whereas the mechanisms of the uptake of GABA and glycine seems to be similar. Author

N92-21274*# Houston Baptist Univ., TX. Dept. of Biology.
THE APPLICABILITY OF NONLINEAR SYSTEMS DYNAMICS CHAOS MEASURES TO CARDIOVASCULAR PHYSIOLOGY VARIABLES Final Report
JOHN C. HOOKER *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 1 7 p Dec. 1991
Avail: NTIS HC/MF A13 CSCL 06/16

Three measures of nonlinear chaos (fractal dimension, Approximate Entropy (ApEn), and Lyapunov exponents) were studied as potential measures of cardiovascular condition. It is suggested that these measures have potential in the assessment of cardiovascular condition in environments of normal cardiovascular stress (normal gravity on the Earth surface), cardiovascular deconditioning (microgravity of space), and increased cardiovascular stress (lower body negative pressure (LBNP) treatments). Author

N92-21276*# Kansas State Univ., Manhattan. Dept. of Kinesiology.
RESOLVING SENSORY CONFLICT: THE EFFECT OF MUSCLE VIBRATION ON POSTURAL STABILITY Final Report
CHARLES S. LAYNE *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 1 14 p Dec. 1991
Avail: NTIS HC/MF A13 CSCL 06/16

The otolith-tilt reinterpretation hypothesis (OTTR) proposes that the central nervous system adapts to weightlessness by reinterpreting all otolith input as linear motion. While interpreting otolith input exclusively as linear motion is functionally useful in space, it is maladaptive upon return to Earth. Astronauts have

reported experiencing illusory sensations during head movement which contributes to postural instability. The effect is assessed of muscle vibration in combination with a variety of sensory conflicts on postural equilibrium. The equilibrium of six healthy subjects was tested using the EquiTest sensory test protocol, with and without the confounding influence of triceps surea vibration. The data were analyzed with repeated measures with vibration, vision status, and platform status as independent variables. All main effects and an interaction between the presence of vision and platform sway referencing were found to be significant. Overall, a 4.5 pct. decrease in postural stability was observed with vibration. The trend of the difference scores between conditions with and without vibration suggests that vibration is most destabilizing when the triceps surea is able to change length during postural sway (i.e., conditions with a fixed support surface). The impact of sway referencing vision was virtually identical to that of eye closure, providing compelling evidence that sway referencing 'nulls out' useful cues about subject sway. Author

N92-21307*# Saint Louis Univ., MO. School of Nursing.
EVALUATION OF CUTANEOUS BLOOD FLOW DURING LOWER BODY NEGATIVE PRESSURE TO PREVENT ORTHOSTATIC INTOLERANCE OF BEDREST Final Report
MARILYN RUBIN *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 2 9 p Dec. 1991
Avail: NTIS HC/MF A09 CSCL 06/16

Orthostatic tolerance is markedly impaired in most of the crewmembers during space flight and could seriously compromise crew safety during and immediately after landing. NASA investigators are studying the use of lower body negative pressure (LBNP) as a countermeasure to this intolerance. It is hypothesized that the continuously changing vascular pressure induced by sinusoidal LBNP with an additional countermeasure of salt and water will help crewmembers to be in a more acceptable physiologic condition to enter the earth's atmosphere. In ground based studies, subjects on bedrest provide the model for studying the physiologic effects of weightlessness. When subjects are treated with sinusoidal LBNP, negative pressures ranging from 0 to -60 mm/Hg are administered during a two hour period. This increases body fluids in the legs and lower body. This paper reports the results of two subjects who were placed on bedrest for six days. The subjects were randomly selected for either the control or treatment mode. The subject receiving the treatment mode ingested salt tablets and water on day 4 of the bedrest period. A ramp LBNP of two hours was next administered to this subject. The control subject did not receive anything during the bedrest period. Laser Doppler was used to measure the cutaneous blood flow of the forearm and calf to monitor vasoconstrictor effects of the baroreceptor reflex. Data indicated that skin blood flow in the treatment subject was higher than baseline in the forearm while the skin blood flow was decreased in the control subject. Author

N92-21312*# Philadelphia Coll. of Pharmacy and Science, PA. Dept. of Pharmacy Practice.
NONINVASIVE PH-TELEMETRIC MEASUREMENT OF GASTROINTESTINAL FUNCTION Final Report
KAREN J. TIETZE *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 2 21 p Dec. 1991
Avail: NTIS HC/MF A09 CSCL 06/16

The purpose of this study was to gain experience with and validate the Heidelberg pH-telemetric methodology in order to determine if the pH-telemetric methodology would be a useful noninvasive measure of gastrointestinal transit time for future ground-based and in-flight drug evaluation studies. The Heidelberg pH metering system is a noninvasive, nonradioactive telemetric system that, following oral ingestion, continuously measures intraluminal pH of the stomach, duodenum, small bowel, ileocecal junction, and large bowel. Gastrointestinal motility profiles were obtained in normal volunteers using the lactulose breath-hydrogen and Heidelberg pH metering techniques. All profiles were obtained in the morning after an overnight fast. Heidelberg pH profiles were obtained in the fasting and fed states; lactulose breath-hydrogen profiles were obtained after a standard breakfast. Mouth-to-cecum transit time was measured as the interval from administration of lactulose (30 ml; 20 g) to a sustained increase in breath-hydrogen of 10 ppm or more. Gastric emptying time was measured as the interval from the administration of the Heidelberg capsule to a sustained increase in pH of three units or more. Author

N92-21329# Wisconsin Univ., Madison.
EFFECTS OF HIGH ALTITUDE HYPOXIA ON LUNG AND CHEST WALL FUNCTION DURING EXERCISE Final Report, 30 Jun. 1988 - 29 Sep. 1991
JEROME A. DEMPSEY 15 Nov. 1991 15 p
(Contract DAMD17-88-C-8053; DA PROJ. 3M1-62787-A-879)
(AD-A244627) Avail: NTIS HC/MF A03 CSCL 06/5

We have defined, more precisely than has been done before, the mechanical limits of the lung and chest wall for the ventilatory requirements of exercise in healthy persons. In most instances in the normal or moderately fit individual, the ventilatory requirement is such that mechanical limitations are barely reached upon expiration, the inspiratory muscles achieve only 40-60 percent of their capacity for pressure generation, and fatigue of the respiratory muscle is not a factor (at least during short term maximum exercise). The greater the maximal VO2, the greater the ventilatory cost and the closer one comes to mechanical limitation of ventilation. Under these conditions, oxygen cost of breathing can approach 13-15 percent of the total VO2 and during long term exercise the diaphragm becomes fatigued. If hypoxia accompanies the exercise, the ventilatory requirement would increase substantially, diaphragm fatigue occurs earlier, mechanical limitations to expiratory flow and inspiratory pressure development occur at lower work-rates, and the diaphragm becomes fatigued in a much shorter exercise time. These factors may contribute significantly to the limitation of exercise performance-especially endurance exercise. GRA

N92-21359# Norwegian Defence Research Establishment, Kjeller.
THE TOXIC EFFECT OF SOMAN ON THE RESPIRATORY SYSTEM
PAL AAS, FRODE FONNUM, ROLF GAUSTAD, and PER WALDAY 1 Mar. 1991 95 p
(NDRE/PUBL-91/1001; ISSN-0800-4412) Avail: NTIS HC/MF A05

The in vitro exposure of rat and guinea pig bronchial smooth muscle to the cholinesterase inhibitor soman (0-(1,2,-trimethylpropyl) methylphosphonofluoridate), in concentrations from 10 nM - 1 micro-M, potentiated the rapid and concentration-dependent increase in the response to acetylcholine (ACh). The soman concentration of 10 nM corresponded to a 65 and 80-100 percent inhibition of acetylcholinesterase (AChE) in rat and guinea pig bronchi, respectively. The apparent affinity to ACh increased without any change in intrinsic activity in this concentration range. In contrast, soman did not alter the apparent affinity or intrinsic activity of carbachol, which supports the suggestion that the effect of soman is entirely due to its anticholinesterase activity. Soman by itself induced contractions which began at 1-10 nM in rat bronchi and at 0.1-1 nM in guinea pig bronchi. This may be explained by its anticholinesterase activity and the subsequent increase in the synaptic concentration of spontaneously released ACh. In guinea pig bronchi, soman had no effect on histamine-induced contractions, indicating no interaction between the cholinergic nervous system and histamine in this tissue. The effect of soman on inhibition of pseudocholinesterase and carboxylesterases (CarbE) was also examined. The results demonstrated that low concentrations of soman induce contractions of the airway smooth muscle and that guinea pig bronchi are more sensitive to soman than bronchi from rat. Author

N92-21378# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
INDIVIDUAL VARIABILITY OF TISSUE TEMPERATURE PROFILE IN THE HUMAN FOREARM DURING WATER IMMERSION

MICHEL B. DUCHARME Jan. 1991 28 p
(DCIEM-91-10; CTN-92-60408) Avail: NTIS HC/MF A03

The purpose of the present study was to investigate the effect of a range of water temperatures (15 to 36 C) on the shape of the tissue temperature profile of the resting human forearm at thermal stability. Tissue temperature was continuously monitored by a calibrated multicouple probe during 3 hours immersion of the forearm. The probe was implanted approximately 9 cm distal from the olecranon process along the ulnar ridge. Tissue temperature was measured every 5 mm, from the longitudinal axis of the forearm (determined from computed tomography scanning) to the skin surface. For all temperature conditions, the temperature profile inside the limb was linear as a function of the radial distance from the forearm axis when the temperature data were averaged for the different groups at each water temperature tested. However, interindividual variability regarding the shape of the temperature profile was observed, in addition to intraindividual variability in 5 of the 15 subjects. A linear profile was observed in 50 percent of the subjects, a profile with convex curvature in 30 percent and a profile with concave curvature in the remaining 20 percent. No significant relationship was observed between the occurrence rate of the different shapes of temperature profile and the water temperature. These data suggest that anatomical structures like bone and artery located at proximity to the pathway of the thermal probe implantation could have influenced the shape of the individual temperature profile inside the forearm. Author (CISTI)

N92-21493# Tell (Richard) Associates, Inc., Las Vegas, NV.
INDUCED BODY CURRENTS AND HOT AM TOWER CLIMBING: ASSESSING HUMAN EXPOSURE IN RELATION TO THE ANSI RADIOFREQUENCY PROTECTION GUIDE
R. A. TELL 7 Oct. 1991 89 p Sponsored by Federal Communications Commission, Washington, DC
(PB92-125186; FCC/OET/RTA-91-01) Avail: NTIS HC/MF A05 CSCL 06/18

The results of the study of the radiofrequency (RF) currents induced in two individuals who climb energized AM broadcast towers for such purposes as tower maintenance are documented. In the study, data on induced currents were obtained using two different AM towers with electrical heights of 0.23 and 0.53 wavelengths. A theoretical analysis of the electric fields near the towers showed that induced body current could be correlated with the radial component of the electric field. These results were consistent with those of an earlier study performed by the Federal Communications Commission and the Environmental Protection Agency. Based on the study, a number of conclusions were reached relative to the question of RF absorption on live AM towers. Author

N92-21714* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 357)
Jan. 1992 69 p
(NASA-SP-7011(357); NAS 1.21:7011(357)) Avail: NTIS HC A04: NTIS standing order as PB91-912300, A03 CSCL 06/5

This bibliography lists 186 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Dec. 1991. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance. Author

N92-21715* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 359)
Feb. 1992 60 p
(NASA-SP-7011(359); NAS 1.21:7011(359)) Avail: NTIS HC A04: NTIS standing order as PB92-912300, A03 CSCL 06/5

This bibliography lists 164 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Jan. 1992. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance. Author

N92-22026* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 358)
Jan. 1992 229 p
(NASA-SP-7011(358); NAS 1.21:7011(358)) Avail: NTIS HC A11; NTIS standing order as PB92-912300, A03 CSCL 06/5

This publication is a cumulative index to the abstracts contained in Supplements 346 through 357 of Aerospace Medicine and Biology: A Continuing Bibliography. It includes seven indexes: subject, personal author, corporate source, foreign technology, contract number, report number and accession number. Author

N92-22030*# MCAT Inst., San Jose, CA.
INCOMPRESSIBLE VISCOUS FLOW COMPUTATIONS FOR THE PUMP COMPONENTS AND THE ARTIFICIAL HEART Final Report
CETIN KIRIS Mar. 1992 36 p Original contains color illustrations
(Contract NCC2-500)
(NASA-CR-190258; MCAT-FR-92-003) Avail: NTIS HC/MF A03; 1 functional color page

A finite-difference, three-dimensional incompressible Navier-Stokes formulation to calculate the flow through turbopump components is utilized. The solution method is based on the pseudocompressibility approach and uses an implicit-upwind differencing scheme together with the Gauss-Seidel line relaxation method. Both steady and unsteady flow calculations can be performed using the current algorithm. In this work, the equations are solved in steadily rotating reference frames by using the steady-state formulation in order to simulate the flow through a turbopump inducer. Eddy viscosity is computed by using an algebraic mixing-length turbulence model. Numerical results are compared with experimental measurements and a good agreement is found between the two. Included in the appendix is a paper on incompressible viscous flow through artificial heart devices with moving boundaries. Time-accurate calculations, such as impeller and diffusor interaction, will be reported in future work. Author

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BEHAVIORAL SCIENCES

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

A92-29549
DEVELOPMENT OF NEW PILOT SELECTION TEST - PRELIMINARY STUDY ON THE SYSTEM OF THE SHORT-TERM MEMORY AND THE ATTENTION DIVISION TEST
KYOICHI NAGATSUKA and YOSHINORI TAKEUCHI Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 15-22. In Japanese. refs

Two types of personal computer-based tests, developed to assess abilities regarding short-term memory and division of attention, have been evaluated using aviation candidates. The results suggest that the tests are promising as predictors of pilot selection. C.D.

A92-30278
ADAPTATION CAPABILITIES OF OPERATORS WITH DIFFERENT WORK CAPACITY DYNAMICS DURING TRANSITION FROM DAYTIME TO NIGHTTIME SHIFTS [ADAPTIVNYE VOZMOZHNOSTI OPERATOROV S RAZLICHNOI DINAMIKOI RABOTOSPOSOBNOSTI PRI PEREKHODE OT DNEVNYKH SMEN K NOCHNYM]
N. I. SYTNIK (NII Gigieny Truda i Profzabolevanii, Kiev, Ukraine) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 37, Sept.-Oct. 1991, p. 98-103. In Russian. refs
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The effect of changing the hours of work shift on the parameters of work capacity and adaptation in operators who change the type of shift from day-time to night-time every two to three days was investigated in 52 operators working in an electric plant. Three types of work-capacity reaction to the day-to-night shift changes were identified: (1) a decrease in work capacity due to the change (19 percent of subjects); (2) no change (62 percent); and (3) an increase in work capacity at night (19 percent). I.S.

A92-31471
OPTIMAL SYMBOL SET SELECTION - A SEMIAUTOMATED PROCEDURE
DONALD L. FISHER and NANCY S. TANNER (Massachusetts, University, Amherst) Human Factors (ISSN 0018-7208), vol. 34, Feb. 1992, p. 79-95. Research supported by Indiana University. refs
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A new model of the visual search process is developed which can improve the design of large symbol sets such as those used by nuclear power plant personnel, air traffic controllers, and battlefield troops. An experiment was conducted to determine whether the new, componential model or an already existing, discriminability model better explains visual search behavior. The results were consistent with the componential model. It is shown how to use the componential model to help automate selection of the optimal symbol set (i.e., the symbol set that minimizes the average time to find a target). Author

A92-31807
SYSTEM IDENTIFICATION - HUMAN TRACKING RESPONSE
BARRY GITTLEMAN, TERRY E. DWAN, and COLLEEN S. SMILEY (U.S. Naval Academy, Annapolis, MD) IEEE Transactions on Education (ISSN 0018-9359), vol. 35, Feb. 1992, p. 31-37. refs
Copyright

An experiment performed to develop transfer functions for human tracking response is discussed. The experiment tested one-dimensional, sine-wave tracking to determine time delay and the transfer function. Using system identification techniques, best models were selected for each of five different frequencies of the test sine-wave input. Bode plots, magnitude, and phase are given for the system that best models the way humans react. Step responses for these models are also given. This process provides an excellent tutorial in programming, system modeling, and simulation. I.E.

N92-20694# Mei Associates, Inc., Lexington, MA.
DESIGNING AN ADVANCED INSTRUCTIONAL DESIGN ADVISOR: INCORPORATING VISUAL MATERIALS AND OTHER RESEARCH ISSUES, VOLUME 4 Interim Report, Jul. 1989 - Nov. 1991
ALINDA FRIEDMAN, MARTHA C. POLSON, and J. M. SPECTOR Dec. 1991 65 p
(Contract F33615-88-C-0003)
(AD-A245107; AL-TP-1991-0017-VOL-4) Avail: NTIS HC/MF A04 CSCL 05/6

The Advanced Instructional Design Advisor (AIDA) is an R and D project being conducted by the Armstrong Laboratory Human Resources Directorate and is aimed at producing automated instructional design guidance for developers of computer-based instructional materials. The process of producing effective computer-based instructional materials is complex and time-consuming. Few experts exist to insure the effectiveness of the process. The content of this paper addresses research issues that pertain to the effective use of visual materials as well as other research issues that arise when attempts are made to automate instructional design. GRA

N92-20713# Medical Research Council, Cambridge (England). Applied Pschology Unit.
THE CENTRAL EXECUTIVE COMPONENT OF WORKING MEMORY Annual Report, 1 Sep. 1990 - 31 Aug. 1991
A. BADDELEY, J. DUNCAN, and H. EMSLIE 31 Oct. 1991 44 p
(Contract AF-AFOSR-0343-90)
(AD-A244916; AFOSR-91-1006TR) Avail: NTIS HC/MF A03 CSCL 05/8

This research is based upon the hypothesis that three different phenomena - behavioral impairments after frontal lobe damage, 'general intelligence' or Spearman's g, and interference between dissimilar concurrent tasks - all reflect the operation of a central executive (CE) system involved in the organization of many different kinds of behavior. Four sets of experiments are presented. One set shows the frontal lobe damage produces massive impairments in 'intelligence tests' based on current problem-solving ability. A second shows that one characteristic frontal error - mismatch between knowledge of a task's requirement and the resultant behavior - can also be reliably produced in normals, and is closely related to g. The third set of experiments is based on the idea that executive processes lose importance as behavior becomes stereotyped or automatic. If so, generating random sequences should load the CE, whatever their particular content, and the experiments indeed suggest that the demands of random generation are similar for verbal and manual materials. Similarly, the fourth set of experiments suggests that correlations between reaction time and g diminish with practice only if there are no switches in mental set. It is proposed that the CE is a system for detection/selection of goal states in novel behavioral settings. GRA

N92-20895# Smith-Kettlewell Inst. of Visual Sciences, San Francisco, CA.
VISUAL PROCESSING OF OBJECT VELOCITY AND ACCELERATION Final Technical Report, 15 Oct. 1988 - 14 Oct. 1991
SUZANNE MCKEE 13 Dec. 1991 136 p
(Contract FQ8671-90-O-1374)
(AD-A244658; AFOSR-91-1030TR) Avail: NTIS HC/MF A07 CSCL 05/8

Six separate projects have explored how velocity and acceleration are encoded in the human visual system: (1) Welch demonstrated that speed discrimination for coherent plaid patterns formed of two superimposed gratings was limited by the speed of the gratings, not the apparent speed of the plaid itself; (2) Bowne et al. and more recently Grzywacz, applied 'motion-energy' models to the psychophysics of speed discrimination; (3) McKee and Welch compared the relative precision of velocity and size constancy, finding little evidence for velocity constancy in human motion processing; (4) Watamaniuk demonstrated that the visual system integrates diverse speeds (2-8 deg/sec) in a random dot display to obtain a precise estimate of the mean speed; (5) McKee and Watamaniuk found that a single point (the signal) moving in apparent motion along a fixed trajectory was easily detected amidst other similar points in random apparent motion (the noise), even though the spatial and temporal characteristics of the signal and noise points were identical on a frame-by-frame basis; and (6) Bravo and Watamaniuk showed that two sets of randomly distributed dots moving in the same direction, but at two very different speeds, formed two transparent planes; discrimination of small changes in the speed of one set of dots was unaffected by the presence of the other dots. GRA

N92-21322# Lawrence Livermore National Lab., CA.
FURTHER OBSERVATIONS REGARDING CREW PERFORMANCE DETAILS ON COMBAT EFFECTIVENESS

R. S. HAGER May 1991 11 p
(Contract W-7405-ENG-48)
(DE92-007270; UCRL-ID-108479) Avail: NTIS HC/MF A03

Previous work investigating the impact of differences in crew performance on battle simulation results has been reexamined using recently corrected Crew III performance data. For the scenario under investigation, it was determined that the previously reported 7 percent difference in average performance of a blue force operating with TOW performance and such a force operating with tank performance has increased to 15 percent with the new data. Furthermore, the performance difference is due primarily to the difference in vehicle shielding which is included as an integral part of the Crew III performance model. (The 15 percent decreases to 1 percent when the Crew III performance is adjusted for average vehicle shielding.) The results of the work reported here indicate that Crew III performance reflects individual performance except in low dose regions where the Crew III model accounts for the probability that degrading symptoms are not occurring to each crewmember. In this case, the overall performance level of each crewmember (and thus also the performance of the crew) increases above the usual representation of individual performance. DOE

N92-21383# Delaware Univ., Newark. Center for Composite Materials.
CONCURRENT ENGINEERING FOR COMPOSITES Final Report
DICK J. WILKINS, VISTASP M. KARBHARI, and JOHN M. HENSHAW Oct. 1991 184 p
(Contract DAAL03-91-G-0004)
(AD-A244714; ARO-28409.1-MS) Avail: NTIS HC/MF A09
CSCL 11/4

The Total Quality Design (TQD) approach serves as a facilitation tool for the coupled decision making that is necessary for composites. The approach serves as a means of enabling the concurrent engineering of composites through the use of a composites design methodology, as well as the Composites Manufacturing and Design Guide (CMDG). This serves as a decision support system, enabling the design team to not only obtain pertinent information in the shortest possible time, but also serves through its discrimination stacks as a means of rejecting concepts that are not feasible with the customers needs and wants. This serves to reduce conflict. Actual case studies are described, and the methodology is further coupled with the TAGUCHI method, to enable efficient quality control in the RTM process. The methodology is structured so as to enable the design team to conquer barriers of communication, and work in an efficient manner for the successful realization of the design cycle. The approach and tools present a concurrent engineering approach to the application of the latest decision making management techniques to the product realization process for composites. GRA

N92-21384# New York Univ., New York. Center for Neural Science.
HIGH ORDER MECHANISM OF COLOR VISION Final Report, 15 Jun. 1990 - 14 Jun. 1991
JOHN KRAUSKOPF 15 Nov. 1991 54 p
(Contract AF-AFOSR-0429-89)
(AD-A244720; AFOSR-91-1007TR) Avail: NTIS HC/MF A04
CSCL 06/4

This report covers our activities since June 15, 1990. The main accomplishments have been: (1) Continued experiments on the variation of color discrimination over color space; (2) Experiments on the influence of color on the perception of coherent motion; (3) Experiments on the effects of chromatic adaptation on color appearance; (4) Electro-physiological experiments on the effects of chromatic stimuli on the responses of neurons physiological experiments on the effects of chromatic stimuli on the responses of neurons in the LGN and the visual cortex of macaque; and (5) The development of a new system for making displays for visual experiments on TV monitors which allows at least 12 bits of accuracy in the specification of the intensity of each of the three primaries. GRA

N92-21467*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUALLY GUIDED CONTROL OF MOVEMENT
WALTER W. JOHNSON, ed. and MARY K. KAISER, ed. Apr. 1991 236 p Workshop held at Moffett Field, CA, 26 Jun. - 14 Jul. 1989
(NASA-CP-3118; A-90200; NAS 1.55:3118) Avail: NTIS HC/MF A11 CSCL 05/9

The papers given at an intensive, three-week workshop on visually guided control of movement are presented. The participants were researchers from academia, industry, and government, with backgrounds in visual perception, control theory, and rotorcraft operations. The papers included invited lectures and preliminary reports of research initiated during the workshop. Three major topics are addressed: extraction of environmental structure from motion; perception and control of self motion; and spatial orientation. Each topic is considered from both theoretical and applied perspectives. Implications for control and display are suggested.

N92-21468*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE USE OF VISUAL CUES FOR VEHICLE CONTROL AND NAVIGATION
SANDRA G. HART and VERNOL BATTISTE *In its* Visually Guided Control of Movement p 7-23 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

At least three levels of control are required to operate most vehicles: (1) inner-loop control to counteract the momentary effects of disturbances on vehicle position; (2) intermittent maneuvers to avoid obstacles, and (3) outer-loop control to maintain a planned route. Operators monitor dynamic optical relationships in their immediate surroundings to estimate momentary changes in forward, lateral, and vertical position, rates of change in speed and direction of motion, and distance from obstacles. The process of searching the external scene to find landmarks (for navigation) is intermittent and deliberate, while monitoring and responding to subtle changes in the visual scene (for vehicle control) is relatively continuous and 'automatic'. However, since operators may perform both tasks simultaneously, the dynamic optical cues available for a vehicle control task may be determined by the operator's direction of gaze for wayfinding. An attempt to relate the visual processes involved in vehicle control and wayfinding is presented. The frames of reference and information used by different operators (e.g., automobile drivers, airline pilots, and helicopter pilots) are reviewed with particular emphasis on the special problems encountered by helicopter pilots flying nap of the earth (NOE). The goal of this overview is to describe the context within which different vehicle control tasks are performed and to suggest ways in which the use of visual cues for geographical orientation might influence visually guided control activities. D.R.D.

N92-21469*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE DISPLAY OF SPATIAL INFORMATION AND VISUALLY GUIDED BEHAVIOR
C. THOMAS BENNETT *In its* Visually Guided Control of Movement p 25-37 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

The basic informational elements of spatial orientation are attitude and position within a coordinate system. The problem that faces aeronautical designers is that a pilot must deal with several coordinate systems, sometimes simultaneously. The display must depict unambiguously not only position and attitude, but also designate the relevant coordinate system. If this is not done accurately, spatial disorientation can occur. The different coordinate systems used in aeronautical tasks and the problems that occur in the display of spatial information are explained. D.R.D.

N92-21470*# Vanderbilt Univ., Nashville, TN. Dept. of Psychology.
PERCEIVING ENVIRONMENTAL STRUCTURE FROM OPTICAL MOTION

JOSEPH S. LAPPIN *In* NASA. Ames Research Center, Visually Guided Control of Movement p 39-61 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

Generally speaking, one of the most important sources of optical information about environmental structure is known to be the deforming optical patterns produced by the movements of the observer (pilot) or environmental objects. As an observer moves through a rigid environment, the projected optical patterns of environmental objects are systematically transformed according to their orientations and positions in 3D space relative to those of the observer. The detailed characteristics of these deforming optical patterns carry information about the 3D structure of the objects and about their locations and orientations relative to those of the observer. The specific geometrical properties of moving images that may constitute visually detected information about the shapes and locations of environmental objects is examined. D.R.D.

N92-21471*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE PERCEPTION OF SURFACE LAYOUT DURING LOW LEVEL FLIGHT
JOHN A. PERRONE (Stanford Univ., CA.) *In its* Visually Guided Control of Movement p 63-74 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

Although it is fairly well established that information about surface layout can be gained from motion cues, it is not so clear as to what information humans can use and what specific information they should be provided. Theoretical analyses tell us that the information is in the stimulus. It will take more experiments to verify that this information can be used by humans to extract surface layout from the 2D velocity flow field. The visual motion factors that can affect the pilot's ability to control an aircraft and to infer the layout of the terrain ahead are discussed. D.R.D.

N92-21472*# Cornell Univ., Ithaca, NY. Dept. of Psychology.
OPTICAL FLOW VERSUS RETINAL FLOW AS SOURCES OF INFORMATION FOR FLIGHT GUIDANCE
JAMES E. CUTTING *In* NASA. Ames Research Center, Visually Guided Control of Movement p 75-86 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

The appropriate description is considered of visual information for flight guidance, optical flow vs. retinal flow. Most descriptions in the psychological literature are based on the optical flow. However, human eyes move and this movement complicates the issues at stake, particularly when movement of the observer is involved. The question addressed is whether an observer, whose eyes register only retinal flow, use information in optical flow. It is suggested that the observer cannot and does not reconstruct the image in optical flow; instead they use retinal flow. Retinal array is defined as the projections of a three space onto a point and beyond to a movable, nearly hemispheric sensing device, like the retina. Optical array is defined as the projection of a three space environment to a point within that space. And flow is defined as global motion as a field of vectors, best placed on a spherical projection surface. Specifically, flow is the mapping of the field of changes in position of corresponding points on objects in three space onto a point, where that point has moved in position.
Author

N92-21473*# Canterbury Univ., Christchurch (New Zealand). Dept. of Psychology.
PERCEPTION AND CONTROL OF ROTORCRAFT FLIGHT
DEAN H. OWEN *In* NASA. Ames Research Center, Visually Guided Control of Movement p 87-97 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

Three topics which can be applied to rotorcraft flight are examined: (1) the nature of visual information; (2) what visual information is informative about; and (3) the control of visual information. The anchorage of visual perception is defined as the distribution of structure in the surrounding optical array or the distribution of optical structure over the retinal surface. A debate was provoked about whether the referent of visual event perception, and in turn control, is optical motion, kinetics, or dynamics. The interface of control theory and visual perception is also considered. The relationships among these problems is the basis of this article. Author

N92-21474*# California Univ., Riverside. Dept. of Psychology.
AN INFORMAL ANALYSIS OF FLIGHT CONTROL TASKS
GEORGE J. ANDERSEN *In* NASA. Ames Research Center, Visually Guided Control of Movement p 99-102 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

Issues important in rotorcraft flight control are discussed. A perceptual description is suggested of what is believed to be the major issues in flight control. When the task is considered of a pilot controlling a helicopter in flight, the task is decomposed in several subtasks. These subtasks include: (1) the control of altitude, (2) the control of speed, (3) the control of heading, (4) the control of orientation, (5) the control of flight over obstacles, and (6) the control of flight to specified positions in the world. The first four subtasks can be considered to be primary control tasks as they are not dependent on any other subtasks. However, the latter two subtasks can be considered hierarchical tasks as they are dependent on other subtasks. For example, the task of flight control over obstacles can be decomposed as a task requiring the control of speed, altitude, and heading. Thus, incorrect control of altitude should result in poor control of flight over an obstacle. Author

N92-21475*# Logicon Technical Services, Inc., Dayton, OH.
SENSITIVITY TO EDGE AND FLOW RATE IN THE CONTROL OF SPEED AND ALTITUDE
LAWRENCE WOLPERT *In* NASA. Ames Research Center, Visually Guided Control of Movement p 103-106 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

A number of studies have examined the potential efficacy of global flow rate and edge rate for specifying changes in self-motion. These have ranged from passive judgements of simulated accelerating self-motion to the active control of altitude in the presence of changes in flow and edge rates. A number of these studies are summarized and an attempt is made to reconcile their respective findings. Author

N92-21476*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MODELING THE PILOT IN VISUALLY CONTROLLED FLIGHT
WALTER W. JOHNSON and ANIL V. PHATAK (Analytical Mechanics Associates, Inc., Sunnyvale, CA.) *In its* Visually Guided Control of Movement p 107-113 Apr. 1991 Previously announced in IAA as A91-14859
Avail: NTIS HC/MF A11 CSCL 05/9

The simplest model for a human operator is a gain with a time delay. However, there have been no comprehensive studies evaluating human control strategies in visually controlled flight. The results of preliminary studies on this topic are described. Human visually guided flight control is important both in low level flight, where it predominates, and in higher altitude flights, where instrument failure is always a potential danger. Two general approaches to this problem, one founded on high order perceptual psychophysics and the other on control systems engineering, are described. Initial results show that the use of control engineering modeling techniques, together with a psychophysical analysis of information in the perspective scene, holds promise for capturing the manual control strategies used during visual flight. Author

N92-21477*# California Univ., Davis. Dept. of Mechanical, Aeronautical, and Materials Engineering.
SIMPLE CONTROL-THEORETIC MODELS OF HUMAN STEERING ACTIVITY IN VISUALLY GUIDED VEHICLE CONTROL
RONALD A. HESS *In* NASA. Ames Research Center, Visually Guided Control of Movement p 115-120 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

A simple control theoretic model of human steering or control activity in the lateral-directional control of vehicles such as automobiles and rotorcraft is discussed. The term 'control theoretic' is used to emphasize the fact that the model is derived from a

consideration of well-known control system design principles as opposed to psychological theories regarding egomotion, etc. The model is employed to emphasize the 'closed-loop' nature of tasks involving the visually guided control of vehicles upon, or in close proximity to, the earth and to hypothesize how changes in vehicle dynamics can significantly alter the nature of the visual cues which a human might use in such tasks. Author

N92-21478*# Wright State Univ., Dayton, OH. Dept. of Psychology.

CONTROL WITH AN EYE FOR PERCEPTION: PRECURSORS TO AN ACTIVE PSYCHOPHYSICS

JOHN M. FLACH *In* NASA. Ames Research Center, Visually Guided Control of Movement p 121-149 Apr. 1991

Avail: NTIS HC/MF A11 CSCL 05/9

The perception-action cycle is viewed within the context of research in manual control. A portrait of a perception-action system is derived from the primitives of control theory in order to evaluate the promise of this perspective of what Warren and McMillan (1984) have termed 'active psychophysics'. That is, a study of human performance that does justice to the intimate coupling between perception and action. Author

N92-21479*# Virginia Univ., Charlottesville. Dept. of Psychology.

CONTEXTUAL SPECIFICITY IN PERCEPTION AND ACTION

DENNIS R. PROFFITT *In* NASA. Ames Research Center, Visually Guided Control of Movement p 151-155 Apr. 1991

Avail: NTIS HC/MF A11 CSCL 05/9

The visually guided control of helicopter flight is a human achievement, and, thus, understanding this skill is, in part, a psychological problem. The abilities of skilled pilots are impressive, and yet it is of concern that pilots' performance is less than ideal: they suffer from workload constraints, make occasional errors, and are subject to such debilities as simulator sickness. Remedying such deficiencies is both an engineering and a psychological problem. When studying the psychological aspects of this problem, it is desirable to simplify the problem as much as possible, and thereby, sidestep as many intractable psychological issues as possible. Simply stated, we do not want to have to resolve such polemics as the mind-body problem in order to contribute to the design of more effective helicopter systems. On the other hand, the study of human behavior is a psychological endeavor and certain problems cannot be evaded. Four related issues that are of psychological significance in understanding the visually guided control of helicopter flight are discussed. First, a selected discussion of the nature of descriptive levels in analyzing human perception and performance is presented. It is argued that the appropriate level of description for perception is kinematical, and for performance, it is procedural. Second, it is argued that investigations into pilot performance cannot ignore the nature of pilots' phenomenal experience. The conscious control of actions is not based upon environmental states of affairs, nor upon the optical information that specifies them. Actions are coupled to perceptions. Third, the acquisition of skilled actions in the context of inherent misperceptions is discussed. Such skills may be error prone in some situations, but not in others. Finally, I discuss the contextual relativity of human errors. Each of these four issues relates to a common theme: the control of action is mediated by phenomenal experience, the veracity of which is context specific. Author

N92-21480*# Illinois Univ., Urbana-Champaign. Dept. of Kinesiology.

VISUALLY GUIDED CONTROL OF MOVEMENT IN THE CONTEXT OF MULTIMODAL STIMULATION

GARY E. RICCIO *In* NASA. Ames Research Center, Visually Guided Control of Movement p 157-174 Apr. 1991

Avail: NTIS HC/MF A11 CSCL 05/9

Flight simulation has been almost exclusively concerned with simulating the motions of the aircraft. Physically distinct subsystems are often combined to simulate the varieties of aircraft motion. Visual display systems simulate the motion of the aircraft relative to remote objects and surfaces (e.g., other aircraft and the terrain). 'Motion platform' simulators recreate aircraft motion relative to the gravitoinertial vector (i.e., correlated rotation and tilt as opposed to the 'coordinated turn' in flight). 'Control loaders' attempt to simulate the resistance of the aerodynamic medium to aircraft motion. However, there are few operational systems that attempt to simulate the motion of the pilot relative to the aircraft and the gravitoinertial vector. The design and use of all simulators is limited by poor understanding of postural control in the aircraft and its effect on the perception and control of flight. Analysis of the perception and control of flight (real or simulated) must consider that: (1) the pilot is not rigidly attached to the aircraft; and (2) the pilot actively monitors and adjusts body orientation and configuration in the aircraft. It is argued that this more complete approach to flight simulation requires that multimodal perception be considered as the rule rather than the exception. Moreover, the necessity of multimodal perception is revealed by emphasizing the complementarity rather than the redundancy among perceptual systems. Finally, an outline is presented for an experiment to be conducted at NASA ARC. The experiment explicitly considers possible consequences of coordination between postural and vehicular control. Author

N92-21481*# *Logicon Technical Services, Inc., Dayton, OH.*

ILLUSORY SELF MOTION AND SIMULATOR SICKNESS

LAWRENCE J. HETTINGER *In* NASA. Ames Research Center, Visually Guided Control of Movement p 175-183 Apr. 1991

Avail: NTIS HC/MF A11 CSCL 05/9

Presented here is a discussion of simulator sickness (with applications to motion sickness and space sickness) based on the notion of senses as perceptual systems, and the sensory conflict theory. Most forms of the sensory conflict theory unnecessarily propose the existence of a neural store. The neural store is thought to consist of a record of previous perceptual experiences against which currently experienced patterns of stimulation are compared. The authors seek to establish that in its most parsimonious form the sensory conflict theory does not require a construct such as the neural store. In its simpler form, the sensory conflict theory complements and extends Gibson's view of the senses as perceptual systems. Author

N92-21482*# York Univ., Toronto (Ontario). Dept. of Psychology.

SPATIAL VISION WITHIN EGOCENTRIC AND EXOCENTRIC FRAMES OF REFERENCE

IAN P. HOWARD *In* NASA. Ames Research Center, Visually Guided Control of Movement p 185-203 Apr. 1991

Avail: NTIS HC/MF A11 CSCL 05/9

It is remarkable that we are able to perceive a stable visual world and judge the directions, orientations, and movements of visual objects given that images move on the retina, the eyes move in the head, the head moves on the body, and the body moves in space. An understanding of the mechanisms underlying perceptual stability and spatial judgements requires precise definitions of relevant coordinate systems. An egocentric frame of reference is defined with respect to some part of the observer. There are four principal egocentric frames of reference, a station-point frame associated with the nodal point of the eye, an retinocentric frame associated with the retina, a headcentric frame associated with the head, and a bodycentric frame (torsocentric) associated with the torso. Additional egocentric frames can be identified with respect to any segment of the body. An egocentric task is one in which the position, orientation, or motion of an object is judged with respect to an egocentric frame of reference. A proprioceptive is a special kind of egocentric task in which the object being judged is also part of the body. An example of a proprioceptive task is that of directing the gaze toward the seen or unseen toe. An exocentric frame of reference is external to the observer. Geographical coordinates and the direction of gravity are examples of exocentric frames of reference. These various frames are listed in tabular form, together with examples of judgements of each type. Author

N92-21483*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUAL DIRECTION AS A METRIC OF VIRTUAL SPACE
STEPHEN R. ELLIS, STEPHEN SMITH (Sterling Software, Palo Alto, CA.), and SELIM HACISALIHZADE *In its* Visually Guided Control of Movement p 205-212 Apr. 1991 Previously announced in IAA as A90-31378
Avail: NTIS HC/MF A11 CSCL 05/9

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

N92-21484*# Charles River Associates, Inc., Cambridge, MA.
PILOT/VEHICLE MODEL ANALYSIS OF VISUALLY GUIDED FLIGHT
GREG L. ZACHARIAS *In* NASA. Ames Research Center, Visually Guided Control of Movement p 213-235 Apr. 1991
Avail: NTIS HC/MF A11 CSCL 05/9

Information is given in graphical and outline form on a pilot/vehicle model description, control of altitude with simple terrain clues, simulated flight with visual scene delays, model-based in-cockpit display design, and some thoughts on the role of pilot/vehicle modeling. Author

N92-21506# Palo Alto Coll., CA. Dept. of Aviation Technology.
FORGETTING A TASK: STRATEGIES FOR ENHANCING THE PILOT'S MEMORY Abstract Only
GARY J. NORTHAM *In* Wichita State Univ., Techfest 18 Proceedings 1 p Jan. 1992
Avail: NTIS HC/MF A03 CSCL 01/2

Action slips are classified as occurring in one of three major categories: (1) intention; (2) activation; and/or (3) triggering. Errors occurring in each of these will have differing causes and consequently differing remedies. This research attempts to define one kind of activation error with an emphasis on defining strategies that may help eliminate that kind of error. Forgetting was identified as an ever occurring problem in the cockpit. It is classified as an activation error because the organized memory unit is not brought into conscious thought so that the task may be accomplished. The fact that activation does not occur depends on the kind of memory that is needed for the task. Recent memory research indicates that there are three stages of memory. This research project seeks to connect this memory research with action slip error descriptions. When a particular error is defined as a memory error, that action may be defined according to a theory of action and a particular memory stage. The particular memory error is then analyzed and suggested strategies provided to help eliminate the problem. Author

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A92-29072
ISSUES ON THE CONTROL OF ROBOTIC SYSTEMS WORN BY HUMANS
H. KAZEROONI (Minnesota, University, Minneapolis) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 386-388. refs
(Contract NSF EET-88-09088)
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The dynamics and control of machines belonging to the category of interaction involving the transfer of both information signals and power is addressed. The information signals sent to the extender computer must be compatible with the power transfer to the extender hardware. This compatibility is presented in terms of closed-loop stability. I.E.

A92-29214* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FAILURE RECOVERY CONTROL FOR SPACE ROBOTIC SYSTEMS
EVANGELOS PAPADOPOULOS and STEVEN DUBOWSKY (MIT, Cambridge, MA) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 2. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 1485-1490. refs
(Contract NAG1-801)
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The problem of controlling a failed joint of a space manipulator is addressed. It is shown that failure-recovery control is possible when dynamic coupling exists between the link whose joint has failed and some other link whose joint is working and when the system inertia matrix is invariant with respect to the failed joint angle. A failure-recovery control technique is developed and applied to two simple examples. I.E.

A92-29258
NONLINEAR MODELING AND DYNAMIC FEEDBACK CONTROL OF THE FLEXIBLE REMOTE MANIPULATOR SYSTEM
F. KARRAY, V. J. MODI, and J. K. CHAN (British Columbia, University, Vancouver, Canada) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 2. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 1909-1912. Research supported by Centers of Excellence Program. refs
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Nonlinear dynamics and control of a class of space-station-based mobile flexible two-link manipulators, normally referred to as the mobile serving system (MSS), are studied. The governing nonlinear, nonautonomous and coupled equations of motion are described, followed by the modal discretization procedure. A parametric response study suggests situations with unacceptable levels of deflections and accelerations for certain proposed missions, as well as station libration and payload positioning errors. An inverse control technique is proposed to achieve high tracking accuracy of the MSS in presence of maneuver induced disturbances. Two different control schemes, both based on the feedback linearization technique, are developed and their relative merits assessed. I.E.

A92-29558
AUTOMATED COCKPITS - KEEPING PILOTS IN THE LOOP
DAVID HUGHES, WILLIAM B. SCOTT, RICHARD G. O'LONE, JEFFREY M. LENOROVITZ, DAVID M. NORTH, EDWARD H. PHILLIPS, and BRECK W. HENDERSON Aviation Week and Space Technology (ISSN 0005-2175), vol. 136, March 23, 1992, p. 50-52, 55, 58 (11 ff.).
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An overview is presented of the various cockpit instrumentation displays being developed for advanced commercial transports with particular emphasis on the increased workload placed on cockpit crews. The evolution of the highly automated glass cockpit, particularly in commercial aircraft, is focusing renewed attention on the challenge of maintaining pilot's situational awareness during flight operations, and keeping them in the loop. Attention is given to advanced cockpit instrumentation and the automated features that are not always compatible with air traffic control requirements. Consideration is given to FAA's national plan for aviation human

factors that will address deficiencies in the pilot-machine interface such as programming flight management systems and monitoring the status of automated systems. R.E.P.

A92-29637*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SURVEY OF INTELLIGENT COMPUTER-AIDED TRAINING
R. B. LOFTIN (Houston, University, TX) and ROBERT T. SAVELY (NASA, Johnson Space Center, Houston, TX) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 6 p. refs
(Contract NAG9-405; NAG9-405A)
(AIAA PAPER 92-0875) Copyright

Intelligent Computer-Aided Training (ICAT) systems integrate artificial intelligence and simulation technologies to deliver training for complex, procedural tasks in a distributed, workstation-based environment. Such systems embody both the knowledge of how to perform a task and how to train someone to perform that task. This paper briefly reviews the antecedents of ICAT systems and describes the approach to their creation developed at the NASA Lyndon B. Johnson Space Center. In addition to the general ICAT architecture, specific ICAT applications that have been or are currently under development are discussed. ICAT systems can offer effective solutions to a number of training problems of interest to the aerospace community. Author

A92-30125
DESIGNING EXERCISE GEAR FOR ZERO GRAVITY
HENRY WHITMORE and STEVE TURPIN (Whitmore Enterprises, Inc., San Antonio, TX) Mechanical Engineering (ISSN 0025-6501), vol. 114, March 1992, p. 70, 71.
Copyright

An account is given of the design of a rowing machine and a treadmill for use aboard the Space Shuttle. The treadmill is the only exercise machine that demonstrably prevents loss of bone density during space travel, through the effect of foot impact on the treadmill; these shocks, however, are structurally distributed throughout the spacecraft and can interfere with delicate zero-gravity experiments. Attention is given to the CAD/CAM process employed for design of these exercise machines. O.C.

A92-30363
INVESTIGATION OF THE BIOMECHANICS OF THE HUMAN HEAD IN MAN-MACHINE CONTROL SYSTEMS. I - THE METHOD FOR EXPERIMENTAL STUDIES [ISSLEDOVANIE BIOMEKHANIKI GOLOVY CHELOVEKA V ERGATICHESKIKH UPRAVLIAIUSHCHIKH SISTEMAKH. I - METODIKA EKSPERIMENTAL'NYKH ISSLEDOVANII]
V. S. MASLOV, A. M. RYTSAREV, V. V. MOSOLOV, and K. V. GRIGOR'EVA Moskovskii Gosudarstvennyi Tekhnicheskii Universitet, Vestnik, Seriia Priborostroenie (ISSN 0236-3933), Jan.-Mar. 1991, p. 41-49. In Russian. refs
Copyright

Attention is given to a noncontact method that makes it possible to determine the position and hodograph of the instantaneous rotation centers of the head of an operator as he is tracking a test object as a function of the angles of displacement and the direction of motion. Mathematical, methodological, and sensor-hardware aspects of this research are examined. B.J.

A92-31042
A SIMULATOR-BASED AUTOMATED HELICOPTER HOVER TRAINER - SYNTHESIS AND VERIFICATION
KALMANJE S. KRISHNAKUMAR (Alabama, University, Tuscaloosa), DINESH SAWAL (Michigan, University, Ann Arbor), J. E. BAILEY (Alabama, University, Tuscaloosa), and JOHN A. DOHME (U.S. Army, Research Institute, Fort Rucker, AL) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. 21, Sept.-Oct. 1991, p. 961-970. Previously cited in issue 21, p. 3434, Accession no. A90-47730. refs
(Contract DAAH01-87-D-0035)
Copyright

A92-31043
ON HUMAN PERFORMANCE IN TELEROBOTICS
VLADIMIR LUMELSKY (Wisconsin, University, Madison) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. 21, Sept.-Oct. 1991, p. 971-982. refs
(Contract NSF DMC-87-12357; NSF IRI-88-05943)
Copyright

Recent experimental attempts to build teleoperated master-slave robot arm manipulators revealed that a human operator has difficulty in interpreting input information (coming, e.g., directly via visual tract or from fixed or moving TV monitors at the scene), and consequently in teleoperation decision making. The problem becomes more pronounced when the slave arm has to operate in a complex environment where every point of the arm body is subject to potential collision. Results are presented of experimental tests with human operators that trace the source of the difficulty to the limitations in human abilities for space orientation and interpretation of geometrical data, and a solution that capitalizes on recent developments in sensor-based motion planning for whole-sensitive robot arms is proposed. The result would be a hybrid system in which global planning is done by a human operator, whereas local collision-free motion is controlled by an assisting autopilot. I.E.

A92-31065
S-TRAINER - SCRIPT BASED REASONING FOR MISSION ASSESSMENT
KATHLEEN M. SWIGGER and BRIGITTE BIRZE (North Texas, University, Denton, TX) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. 21, Sept.-Oct. 1991, p. 1243-1251. Research supported by USAF. refs
Copyright

The design and implementation of script-based reasoning techniques integrated into a rule-based diagnoser for the purpose of debriefing pilots who have completed a bomber training mission are reported. The system was developed on a Symbolics Lisp Machine using Flavors and has the capability of reasoning about tactical situations and providing plausible explanations of these activities as they evolve. Prestored mission events serve as script templates that are matched against actual events and the time relation between events. The intelligent training system then generates multiple hypotheses, diagnoses both pilot and crew errors, and generates a written evaluation of the mission along with a set of graphics that is used to supplement the written report. I.E.

A92-31301
SPACE STATION AND ADVANCED EVA; PROCEEDINGS OF THE 21ST INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SYSTEMS, SAN FRANCISCO, CA, JULY 15-18, 1991
Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-872), 1991, 237 p. For individual items see A92-31302 to A92-31322.
(SAE SP-872; ISBN 1-56091-152-2) Copyright

The present volume discusses such Space Station Freedom-related and EVA-related as a neutral-buoyancy portable life-support system (LSS), transient thermal modeling for a neutrally-buoyant cryofluid delivery system, extravehicular mobility units (EMUs) for future missions, human factors in spacesuit-glove design, a power-assisted EVA glove, casting technologies applicable to space suits, Space Shuttle EMU thermal vacuum test results, information requirements for Space Station Freedom EVA, and EVA capability enhancement via telerobotics. Also discussed are an ESA spacesuit design concept's verification, sublimator technology for the ESA spacesuit, a design process for an interplanetary mission EVA system, and candidates for fusible heat-sink materials. O.C.

A92-31302* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPARISON OF METAL OXIDE ABSORBENTS FOR REGENERATIVE CARBON DIOXIDE AND WATER VAPOR REMOVAL FOR ADVANCED PORTABLE LIFE SUPPORT SYSTEMS
GREG T. STONESIFER (Lockheed Engineering and Sciences Co., Houston, TX), CRAIG H. CHANG (Allied-Signal Aerospace Co., Torrance, CA), ROBERT J. CUSICK (NASA, Johnson Space Center, Houston, TX), and JOAN M. HART (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., CA) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 1-10. *refs*
(Contract NAS9-17900)
(SAE PAPER 911344) Copyright

Metal-oxide absorbents (MOAs) have a demonstrated capability for removal of both metabolic CO2 and H2O from breathing atmospheres, simplifying portable life support system (PLSS) design and affording reversible operation for regeneration. Attention is presently given to the comparative performance levels obtained by silver-oxide-based and silver/zinc-oxide-based systems, which also proved to be longer-lasting than the silver oxide-absorber system. The silver/zinc system is found to substantially simplify the ventilation loop of a prospective Space Station Freedom PLSS. O.C.

A92-31303* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NEUTRAL BUOYANCY PORTABLE LIFE SUPPORT SYSTEM PERFORMANCE STUDY
CHI-MIN CHANG (NASA, Johnson Space Center, Houston, TX), BRUCE C. CONGER, and JOHN V. IOVINE (Lockheed Engineering and Sciences Co., Houston, TX) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 11-25. refs
(SAE PAPER 911346) Copyright

The Neutral Buoyancy Portable Life Support System (NBPSS) has been designed to support astronaut underwater training activities associated with EVA operations. The performance of competing NBPSS configurations has been analyzed on the basis of a modified 'Metabolic Man' program. NBPSS success is dependent on the development of novel cryogen supply tank and liquid-cooling garment vaporizer. Attention is given to mass and thermal balances and the evaluation results for the vent-loop ejector and heat-exchanger designs. O.C.

A92-31308
SPACESUIT GLOVE THERMAL MICROMETEOROID GARMENT PROTECTION VERSUS HUMAN FACTORS DESIGN PARAMETERS
JEFF CHODACK and PHIL SPAMPINATO (ILC Dover, Frederica, DE) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 67-83. refs
(SAE PAPER 911383) Copyright

The thermal micrometeoroid garment (TMG) is a multilayered fabric assembly covering and protecting the Space Shuttle EVA suit's pressurized gloves. The TMG must both protect against space hazards that may abrade, puncture, or heat the glove, while meeting critical human-factors requirements to maximize tactility and grip while minimizing fatigue. Attention is presently given to pegboard-based glove dexterity test procedures and results which illustrate the importance of the TMG to glove performance. Lessons learned regarding the use of velcro fasteners and knurled surfaces are discussed. O.C.

A92-31309* National Aeronautics and Space Administration, Washington, DC.
A PROTOTYPE POWER ASSIST EVA GLOVE
JOHN A. MAIN, STEVEN W. PETERSON, and ALVIN M. STRAUSS (Vanderbilt University, Nashville, TN) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 85-93. Research supported by NASA. refs
(SAE PAPER 911384) Copyright

The most recent generation of space suit EVA gloves has addressed the problem of loose fit and stiffness in the fingers, but it remains difficult to build a glove assembly with low metacarpophalangeal joint stiffness. Fatigue due to constantly displacing the glove from a neutral position has been reported as the limiting factor in some EVA activities. This paper outlines an actuation system that uses gas filled bladders attached to the back of the EVA glove to provide the necessary force to bend the glove at the metacarpal joint, thus providing greater endurance during finger grasping tasks. A simple on-off controller senses hand movement through small pressure sensors between the finger and the glove restraint. The controller then fills or exhausts the bladders on the back of the glove to effectively move the neutral position of the glove as the hand inside moves. Author

A92-31310
ANALYSIS OF SPACE SUIT MOBILITY BEARINGS USING THE FINITE ELEMENT METHOD
JOSEPH V. WELCH (ILC Dover, Frederica, DE) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 95-112. refs
(SAE PAPER 911385) Copyright

During the redesign of the Shuttle Space Suit Waist Bearing, ILC Dover investigated using the Finite Element Method as a means to evaluate a bearings' deflection characteristics. The minimization of bearing torque to reduce crew member fatigue is one of the design goals for the bearings' use in the space suit. A structural analysis method was developed that predicts relative radial deflections, ball loads, and contact angle, some of the determinants of bearing torque. This technique offers deflection and ball load information to the design engineer that have previously not been available until after prototype construction and testing. Having the Finite Element Analysis capability for space suit bearings played an important role in the design of a zero prebreathe suit development bearing. Author

A92-31311
CASTING TECHNOLOGY AS APPLIED TO ADVANCED SPACE SUIT CONCEPTS
RALPH A. TOSCANO, JR. (Air-Lock, Inc., Milford, CT) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 113-123. refs
(SAE PAPER 911386) Copyright

Such advanced technologies and methods as CAD/CAM, FEM, soft tooling and computerized numerical control have been employed to render feasible the investment casting of hard EVA space suit elements from Al alloys, with minimal subsequent machining. Such castings have been found to be reliable, dimensionally accurate and economical, relative to components machined from solid billets. Attention is given to cast components for the AX-5 hard space suit design; graphs are presented for wall thickness vs span and tolerancing design considerations, together with a tabulation of casting Al alloy properties in various tempers. O.C.

A92-31312
DEVELOPMENT OF A PORTABLE CONTAMINATION DETECTOR FOR USE DURING EVA
PETER E. GLASER, GARY C. KOGER, DALE N. LASON, JAMES

R. VALENTINE (Arthur D. Little, Inc., Cambridge, MA), JOSEPH H. BROOKS, ALBERT C. COPELAND, and ROBERT L. FROST (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 125-134. refs
(SAE PAPER 911387) Copyright

Initial efforts in the development of an EVA portable contamination detector (EVA PCD) for use by the EVA crew have resulted in the selection and preliminary testing of a concept based upon time-of-flight (TOF) mass spectrometry. The EVA PCD will be a compact, man-portable device intended for use in the ambient vacuum outside the Space Station. It will be used to monitor the surfaces of the EVA suits and mobility units for the presence of potentially toxic contaminants, such as hydrazine propellants and oxidizers, which might otherwise be inadvertently carried into the interior of the Station. The EVA PCD will also be used to locate small leaks of heat exchange fluids in the outer surface of the Station. This paper describes some key performance needs for the EVA PCD system, approaches taken to interpreting those needs, and some of the results of tradeoff analyses which led to the selection of the TOF concept. Some results from initial experimental tests of a TOF unit are presented. Author

A92-31315
DESIGN AND TESTING OF AN ELECTRONIC EXTRAVEHICULAR MOBILITY UNIT (EMU) CUFF CHECKLIST
CHARLES H. SIMONDS and CHEN-HSIANG CHEN (Lockheed Engineering and Sciences Co., Houston, TX) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 159-167. refs
(SAE PAPER 911529) Copyright

Design considerations and test results are presented for a breadboard version of an EMU electronic cuff checklist (ECC) encompassing an electroluminescent flat-panel display, control and data-storage electronics, a serial data port, and a battery. Display test results indicate that the display can be read in a wide range of illumination conditions, including full insolation. Water-tank weightless environment test results of a volumetric mockup of the ECC show that a cuff checklist which will not compromise astronaut reach and mobility can be designed. O.C.

A92-31316
INCREASING EVA CAPABILITY THROUGH TELEROBOTICS AND FREE FLYERS
DAVID E. ANDERSON, LISA M. ROCKOFF, and LISA K. EVELSIZER (McDonnell Douglas Space Systems Co., Space Station Div., Huntington Beach, CA) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 169-179. refs
(SAE PAPER 911530) Copyright

The advancement of EVA performance toward large space structure assembly capabilities entailed by the projected Space Station Freedom, through such technologies as free-flyers and telerobotics, is presently illustrated in light of results from aerobrake and propellant tank farm neutral buoyancy testing. Attention is given to 8-psi EVA suits, EVA end-effectors, latch interfaces, EVA restraint methods, the Standard Quick-Release Universal Interface Device, 'zip' nuts, and orbital-replacement unit handoffs. Telerobotics for EVA require effective communications, an astronaut-positioning system, and high tooling commonality; free-flyers entail attention to monitoring camera views, hardware transportation, and crew and equipment retrieval. O.C.

A92-31317
EUROPEAN SPACE SUIT DESIGN CONCEPT VERIFICATION
A. I. SKOOG (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) and Y. OLLIVIER (Dassault Aviation, Saint-Cloud, France) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 181-194. Research supported by ESA. refs
(SAE PAPER 911575) Copyright

Test results are presented for the technology-breadboard of the ESA EVA Space Suit, whose hardware components encompassed gloves, shoulder joints, seals and bearings, a heat-removal sublimator, high pressure oxygen regulators, an integrated fan-pump separator, biomedical sensors, and a voice processor. Attention is given to the design details of these suit components. A large performance data base has been compiled in the course of breadboard testing. The suit reference concept fulfils the given EVA system performance requirements in all regards except overall mass, lying 10 percent above the design target. O.C.

A92-31319
DEVELOPMENT OF SUBLIMATOR TECHNOLOGY FOR THE EUROPEAN EVA SPACE SUIT
CHRISTINE PLANERT, PETER KREMER (Nord-micro Elektronik Feinmechanik AG, Frankfurt am Main, Federal Republic of Germany), and JOHANNES WITT (ESTEC, Noordwijk, Netherlands) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 201-207. Research supported by ESA.
(SAE PAPER 911577) Copyright

Heat generated during EVA operations by the European Space Suit will be dissipated via water sublimation from ice to vapor at pressures below 6 hPa. The sublimator consists of a porous plate with feedwater distribution underneath and a liquid/gas heat-exchanger component. A breadboard model of this device has been constructed from stainless steel and tested to demonstrate concept feasibility and performance capabilities. Attention is given to the detailed design features of the porous plate. O.C.

A92-31320
DEVELOPMENT OF A PP CO2 SENSOR FOR THE EUROPEAN SPACE SUIT
KLAUS AMMANN (Draegerwerk AG, Luebeck, Federal Republic of Germany) and JOHANNES WITT (ESTEC, Noordwijk, Netherlands) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 209-218. Research supported by ESA. refs
(SAE PAPER 911578) Copyright

A summary of a technology research program is given aiming at the development of a CO2 partial pressure sensor suitable for monitoring the PP CO2 inside the oxygen ventilation loop of the EVA life support module. At first, a trade-off of candidate sensor concepts is presented. As a result, the infrared optical sensor concept has been selected. In the frame of a discussion on basic facts of IR absorption the rationale for the selected configuration of the IR sensor is given. A breadboard model of the PP CO2 sensor together with a test set-up has been established. The sensor was subjected to a test program consisting of two separate test periods. The main results are given. Finally, the findings are discussed in the light of the development of future flight hardware. Author

A92-31322* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FUSIBLE HEAT SINK MATERIALS - AN IDENTIFICATION OF ALTERNATE CANDIDATES
GUNA SELVADURAY (San Jose State University, CA) and CURTIS LOMAX (NASA, Ames Research Center, Moffett Field, CA) IN: Space Station and advanced EVA; Proceedings of the 21st International Conference on Environmental Systems, San

Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 225-231. refs
(Contract NCC2-260)
(SAE PAPER 911345) Copyright

Fusible heat sinks are a possible source for thermal regulation of space suited astronauts. An extensive database search was undertaken to identify candidate materials with liquid solid transformations over the temperature range of -18 C to 5 C; and 1215 candidates were identified. Based on available data, 59 candidate materials with thermal storage capability, DeltaH values higher than that of water were identified. This paper presents the methodology utilized in the study, including the decision process used for materials selection. Author

A92-31326
SPACECRAFT WATER QUALITY: MAINTENANCE AND MONITORING; PROCEEDINGS OF THE 21ST INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SYSTEMS, SAN FRANCISCO, CA, JULY 15-18, 1991
Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-874), 1991, 208 p. For individual items see A92-31327 to A92-31344.
(SAE SP-874; ISBN 1-56091-154-9) Copyright

The present conference on the maintenance and monitoring of spacecraft water quality examines the engineering and biomedical issues related to the recycling of water directly from waste-water products, and the papers presented focus on: (1) designing and testing reclamation systems; (2) determining the health-related requirements for recycled water; and (3) verifying that the requirements can be met for the U.S. manned space program. Specific issues addressed include the water-quality program for the Space Station Freedom, the thyroid effects of iodine and iodide in water, the formation and control of biofilm in spacecraft water systems, a total organic carbon analyzer, and an analysis of urine- and thermal-pretreatment methods. Also reported are a preliminary ECLSS waste-water model, water reclamation by means of multifiltration, mercury and polar-organics monitoring in water-quality analysis, a regenerable biocide delivery unit, and the destruction of biofilm with Pseudomonas aeruginosa as architect. C.C.S.

A92-31327* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
WATER QUALITY PROGRAM ELEMENTS FOR SPACE STATION FREEDOM
RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX), RAGHUPATHY RAMANATHAN, JOHN E. STRAUB, and JOHN R. SCHULTZ (Krug International Corp., Technology Life Sciences Div., Houston, TX) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 1-21. refs
(SAE PAPER 911400) Copyright

A strategy is outlined for the development of water-quality criteria and standards relevant to recycling and monitoring the in-flight water for the Space Station Freedom (SSF). The water-reclamation subsystem of the SSF's ECLSS is described, and the objectives of the water-quality are set forth with attention to contaminants. Quality parameters are listed for potable and hygiene-related water including physical and organic parameters, inorganic constituents, bactericides, and microbial content. Comparisons are made to the quality parameters established for the Shuttle's potable water and to the EPA's current standards. Specific research is required to develop in-flight monitoring techniques for unique SSF contaminants, ECLSS microbial control, and on- and off-line monitoring. After discussing some of the in-flight water-monitoring hardware it is concluded that water reclamation and recycling are necessary and feasible for the SSF. C.C.S.

A92-31328* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THYROID EFFECTS OF IODINE AND IODIDE IN POTABLE WATER
RICHARD J. BULL, KARLA D. THRALL, and TODD T. SHERER (Washington State University, Pullman) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 23-26. refs
(Contract NAG9-226)
(SAE PAPER 911401) Copyright

Experiments are reviewed which examine the comparative toxicological effects of iodide (I) and iodine (I2) when used to disinfect drinking water. References are made to a subchronic study in rats, a comparison of the distribution of radiolabeled I and I2, and a demonstration of thyroxine formation in the gastrointestinal tract. The results of the study of the rats are examined in detail; the findings show that I and I2 have opposite effects on the concentrations of thyroid hormones in blood. Iodide slightly decreases circulating thyroxine, while I2 significantly increases the thyroxine concentrations, decreases triiodothyronine levels, and does not change the weight of the thyroid gland. The related effects of I2 ingestion are set forth in detail and are shown to be unique to I2 contamination. Iodine can counteract the effects of iodide and should therefore be used as a disinfectant in drinking water. C.C.S.

A92-31329* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DISINFECTION SUSCEPTIBILITY OF WATERBORNE PSEUDOMONADS AND LEGIONELLAE UNDER SIMULATED SPACE VEHICLE CONDITIONS
GORDON A. MCFETERS, BARRY H. PYLE, SHELLEY K. WATTERS, KARI L. CARGILL, and FEIPENG P. YU (Montana State University, Bozeman) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 27-32. refs
(Contract NAS9-17346)
(SAE PAPER 911402) Copyright

The sensitivity of waterborne bacteria from iodinated systems to iodine is examined with particular attention to the recovery of the organisms. The use of iodine as a disinfectant for space-vehicle water is described, and references are made to studies of iodine sensitivity and the relationship between growth rate and iodine sensitivity. Growth following iodination is discussed, and bacterial responses to nutrient restriction are examined for both P aeruginosa and Legionella pneumophila. The low level of organic nutrients in spacecraft water allows the selection for bacteria that are less sensitive to halogens. The formation of biofilms within the water-treatment system enhances bacterial resistance to iodine, and in the case of high-quality water it is shown that sublethal doses of iodine can stimulate bacterial growth. Water treatment should therefore be based on antecedent growth conditions, nutrient limitation, biofilm formation, and ambient selective pressures. C.C.S.

A92-31330* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BIOFILM FORMATION AND CONTROL IN A SIMULATED SPACECRAFT WATER SYSTEM - TWO-YEAR RESULTS
JOHN R. SCHULTZ, ROBERT D. TAYLOR, DAVID T. FLANAGAN, SANDRA E. CARR, REBEKAH J. BRUCE, JUDY V. SVOBODA, M. H. HULS (Krug International Corp., Technology Life Sciences Div., Houston, TX), RICHARD L. SAUER, and DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 33-43. refs
(SAE PAPER 911403) Copyright

The ability of iodine to maintain microbial water quality in a simulated spacecraft water system is being studied. An iodine level of about 2.0 mg/L is maintained by passing ultrapure influent water through an iodinated ion exchange resin. Six liters are withdrawn daily and the chemical and microbial quality of the water is monitored regularly. Stainless steel coupons used to monitor biofilm formation are being analyzed by culture methods, epifluorescence microscopy, and scanning electron microscopy. Results from the first two years of operation show a single episode of high bacterial colony counts in the iodinated system. This growth was apparently controlled by replacing the iodinated ion exchange resin. Scanning electron microscopy indicates that the iodine has limited but not completely eliminated the formation of biofilm during the first two years of operation. Significant microbial contamination has been present continuously in a parallel noniodinated system since the third week of operation. Author

A92-31332* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
BIOBURDEN CONTROL FOR SPACE STATION FREEDOM'S ULTRAPURE WATER SYSTEM
DONALD W. SNODGRASS (Teledyne Brown Engineering, Huntsville, AL), ELIZABETH B. RODGERS (NASA, Marshall Space Flight Center, Huntsville, AL), DON OBENHUBER, and TIM HUFF (Sverdrup Technology, Inc., Huntsville, AL) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 61-67. refs
(SAE PAPER 911405) Copyright

Bioburden control is one of the challenges for the Ultrapure Water System on Space Station Freedom. Bioburden control must enable the system to deliver water with a low bacterial count as well as maintain biological contamination at a manageable level, to permit continued production of quality water. Ozone has been chosen as the primary means of Bioburden control. Planned tests to determine the effectiveness of ozone on free-floating microbes and biofilms are described. Author

A92-31333* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REGENERABLE BIOCIDE DELIVERY UNIT
GERALD V. COLOMBO, CLIFFORD D. JOLLY (Umpqua Research Co., Myrtle Creek, OR), and RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 69-73.
(SAE PAPER 911406) Copyright

The Microbial Check Valve (MCV) is used on the Space Shuttle to impart an iodine residual to the drinking water to maintain microbial control. Approximately twenty MCV locations have been identified in the Space Station Freedom design, each with a 90-day life. This translates to 2400 replacement units in 30 years of operation. An in situ regeneration concept has been demonstrated that will reduce this replacement requirement to less than 300 units based on data to date. A totally automated system will result in significant savings in crew time, resupply requirements, and replacement costs. An additional feature of the device is the ability to provide a concentrated biocide source (200 mg/liter of I2) that can be used to superiodinate systems routinely or after a microbial upset. Author

A92-31334
DEVELOPMENT OF THE PROCESS CONTROL WATER QUALITY MONITOR FOR SPACE STATION FREEDOM
E. L. JEFFERS (Astro International Corp., Houston, TX) and CLIFFORD D. JOLLY (Umpqua Research Co., Myrtle Creek, OR) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 75-101. refs
(SAE PAPER 911432) Copyright

On-line monitoring of the effluent from the Space Station Freedom (SSF) water reclamation process determines acceptable quality for delivery to tanks supplying the crew's potable and hygiene water needs. TOC, pH, conductivity and iodine (biocide) are continuously monitored by the integrated, computer-controlled Process Control Water Quality Monitor (PCWQM). This paper describes the development of the system with emphasis on membrane gas-liquid separation and reagentless oxidation necessary to adapt standard TOC analysis to the unique requirements of the space environment. Author

A92-31336* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE DEVELOPMENT OF A VOLATILE ORGANICS CONCENTRATOR FOR USE IN MONITORING SPACE STATION WATER QUALITY
ITAMAR BODEK, DANIEL J. EHNTHOLT, THOMAS J. STOLKI, JAMES R. VALENTINE (Arthur D. Little, Inc., Cambridge, MA), RUDY TRABANINO, JOHANNA V. WEBB (McDonnell Douglas Space Systems Co., Huntington Beach, CA), and RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 115-129. refs
(SAE PAPER 911435) Copyright

A breadboard concept of a volatile organics concentrator (VOC) is manufactured and tested for optimized water-quality analysis in a space environment. The VOC system is attached to a gas chromatograph/mass spectrometer to analyze the volatile chemicals relevant to the operation of Space Station Freedom. The preliminary tests include: (1) comparisons with analyses based on direct on-column injections of standards; (2) analyses of iodinated volatile organics; (3) comparisons of nitrogen vs helium as the chromatography carrier gas; and (4) measurements of collection efficiency. The VOC can analyze EPA method-624 analytes at comparable detection using flame-ionization detection and can analyze volatile iodinated compounds. The breadboard has good reproducibility and can use nitrogen as a carrier gas; good results are noted for the collection and concentration levels and for water removal. C.C.S.

A92-31338
SELECTED TOPICS IN WATER QUALITY ANALYSIS - MERCURY AND POLAR ORGANICS MONITORING
DAVID E. BURCHFIELD, LEIGH EVANS, WILLIAM NIU (Perkin-Elmer Corp., Pomona, CA), ITAMAR BODEK, and DANIEL J. EHNTHOLT (Arthur D. Little, Inc., Cambridge, MA) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 139-145. refs
(SAE PAPER 911437) Copyright

A breadboard system is described and tested that can detect total mercury levels in water by means of microgravity-compatible variations of standard methods. The total mercury sensor is based on solid-phase sorption of mercury metal from the analyte followed by determination at a gold-film electrode. Sodium borohydride is utilized as the reagent for decomposing organomercury compounds and generating mercury reduction. A volatile organic concentrator extracts the organics and gas chromatography/mass spectroscopy is used to detect phenols at levels below 1 ppb. Detection levels below 500 ppb are reported for short-chain aliphatic alcohols in samples injected directly on a DB624 column. Although the methods assume that the water supply to be tested in the spacecraft is relatively clean, the present processes are shown to require minimum sample preparation and relatively simple extractions and analyses. C.C.S.

A92-31339
TECHNICAL REVIEW - COMPARISON OF IC AND CE FOR MONITORING IONIC WATER CONTAMINANTS ON SSF
RANDOLPH W. SCHWEICKART (McDonnell Douglas Space Systems Co., Huntington Beach, CA), SANDRA E. CARR, and PAUL D. MUDGETT (Krug International Corp., Dayton, OH) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 147-155. refs
(SAE PAPER 911438) Copyright

The use of ion chromatography (IC) is compared to that of capillary electrophoresis (CE) for measuring ionic contaminants in the Space Station Freedom (SSF) water system. The principles of IC and CE are set forth with illustrations of system components and descriptions of their respective processes. The capabilities of IC and CE analyses are examined in the context of the SSF requirements for contaminant monitoring as defined by NASA for anion, cation, and transition-metal analyses. IC methods are shown to be generally more precise than CE methods based on their respective relative standard deviations for retention time and peak area. A comparison of the performances of IC and CE designs demonstrates that CE is more efficient in terms of operation under microgravity, the mass and volume of system components, and automation potential. CE instrumentation is shown to be accurate and suitable for the SSF environment, although more testing is required to prove the long-term suitability of CE testing. C.C.S.

A92-31340
AN ANALYSIS OF URINE PRETREATMENT METHODS FOR USE ON SPACE STATION FREEDOM
STANLEY G. HOWARD and JANIE H. MIERNIK (Boeing Defense and Space Group, Huntsville, AL) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 157-166. refs
(SAE PAPER 911549) Copyright

Water reclamation from human urine will be the basis of the closed loop Water Recovery Management (WRM) system on Space Station Freedom (SSF). Pretreatment is necessary to collect and process urine, fix and prevent ammonia formation, inhibit microbial growth and prevent solids precipitation. Pretreatment must be accomplished immediately upon collection to prevent damage to urine collection and handling equipment. Currently, a chemical injection scheme is an integral part of the SSF Urinal design. The reagents used will be based on compatibility with Urinal and Urine Processor components, performance of necessary pretreatment functions, quality of reclaimed water, resupply costs and development risks. These factors are compared for various pretreatment methods currently under consideration for use on SSF. Author

A92-31341* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PRELIMINARY ECLSS WASTE WATER MODEL
DONALD L. CARTER, DONALD W. HOLDER, JR. (NASA, Marshall Space Flight Center, Huntsville, AL), KEVIN ALEXANDER, R. G. SHAW, and JOHN K. HAYASE (Boeing Aerospace Co., Seattle, WA) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 167-173. refs
(SAE PAPER 911550) Copyright

A preliminary waste water model for input to the Space Station Freedom (SSF) Environmental Control and Life Support System (ECLSS) Water Processor (WP) has been generated for design purposes. Data have been compiled from various ECLSS tests and flight sample analyses. A discussion of the characterization of the waste streams comprising the model is presented, along with a discussion of the waste water model and the rationale for the inclusion of contaminants in their respective concentrations. The major objective is to establish a methodology for the development of a waste water model and to present the current state of that model. Author

A92-31342
FUNCTIONAL DESCRIPTION OF THE ION EXCHANGE AND SORBENT MEDIA USED IN THE ECLSS WATER PROCESSOR UNIBEDS
CLARENCE D. COLLEY (Boeing Defense and Space Group, Huntsville, AL) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 175-188. refs
(SAE PAPER 911551) Copyright

This paper reviews some of the historical data and background surrounding the evolution and development of the Multifiltration Unibeds utilized in the ECLSS WRM water processors. Data will be presented illustrating some of the problem areas associated with previous Unibed designs and some of the progress being made toward development of flight hardware used in the treatment of water for crew use aboard Space Station Freedom (SSF). The ECLSS Water Recovery Management system (WRM) supplies water for the crew and for scientific experimentation. Specific problem areas will be discussed with recommendations that will avoid some of the pitfalls that may be encountered in design. Author

A92-31343
SPACE STATION HYGIENE WATER RECLAMATION BY MULTIFILTRATION
DAVID F. PUTNAM, WILLIAM F. MICHALEK (Umpqua Research Co., Myrtle Creek, OR), and TERRI VAN PELT (Hamilton Standard, Windsor Locks, CT) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 189-194. refs
(SAE PAPER 911553) Copyright

The multifiltration subsystem for baseline hygiene-water reclamation on the Space Station Freedom (SSF) is described in terms of requirements, waste-water sources, and technology. The subsystem utilizes sorbents to remove organic and inorganic contaminants, a sterilization unit to kill microorganisms, and a cold filter to remove particulate contaminates larger than at least 0.5 micron. Specific attention is given to the 'unibed' replaceable sorption units and to the placement of the units for maximum saturation and utility. A process-control water quality analyzes the hygiene water which the multifiltration system processes from wash water and urine. Testing of the unibed shows that the concept permits low-energy reclamation of 100 percent of the water and that further testing is needed to identify the optimal sorbents for expected contaminants. The multifiltration subsystem uses relatively few components and moving parts and is suitable for the SSF hygiene-water reclamation system. C.C.S.

A92-31344
THERMAL PRETREATMENT OF WASTE HYGIENE WATER
FRANK C. GARMON and ROBERT K. AMES (Umpqua Research Co., Myrtle Creek, OR) IN: Spacecraft water quality: Maintenance and monitoring; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 195-200.
(SAE PAPER 911554) Copyright

Thermal pretreatment is examined as part of the microbial-control methodology for waste hygiene water as a way to minimize the energy required for microbial control. Experimental studies are conducted which describe the reduction of microbial populations corresponding to various thermal cycles with attention given to water inoculated with thermophilic bacteria. Biofilm formation is then studied with and without thermal cycling by examining the surfaces of materials to be used in the large-scale

spacecraft system. Most microbes in combined wastewater are killed by temperatures above 85 C, although naturally occurring thermophiles can survive 4 hr at 95 C. The survivability of the thermophilic population at temperatures below autoclave levels shows that lower-temperature treatment is not adequate for total microbial eradication. Biofilm formation and subsequent sloughing are shown to be significant factors in maintaining wastewater-treatment equipment. C.C.S.

A92-31351
SPACE STATION ECLSS AND THERMAL CONTROL; PROCEEDINGS OF THE 21ST INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SYSTEMS, SAN FRANCISCO, CA, JULY 15-18, 1991
Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-875), 1991, 366 p. For individual items see A92-31352 to A92-31377.
(SAE SP-875; ISBN 1-56091-155-7) Copyright

Topics presented include an integrated energy balance analysis for SSF, high conductance thermal interface concept for space applications, heat pump evaluation for Space Station radiator orientation profile, heat pump evaluation for Space Station ATCS evolution, and SSF for environmental database system for MSFC testing. Also presented are an assessment of the readiness of vapor compression distillation for spacecraft wastewater processing, shower water recovery by UF/RO, SPE water electrolyzers for closed environment life support, and developing real-time control software for SSF CO2 removal. R.E.P.

A92-31358* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PHASE III INTEGRATED WATER RECOVERY TESTING AT MSFC - PARTIALLY CLOSED HYGIENE LOOP AND OPEN POTABLE LOOP RESULTS AND LESSONS LEARNED
R. M. BAGDIGIAN, M. S. TRAWEEK (NASA, Marshall Space Flight Center, Huntsville, AL), G. K. GRIFFITH, and M. R. GRIFFIN (NASA, Marshall Space Flight Center; Sverdrup Technology, Inc., Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 59-74. refs
(SAE PAPER 911375) Copyright

A series of tests has been conducted at the NASA Marshall Space Flight Center (MSFC) to evaluate the performance of a predevelopment water recovery system. Potable, hygiene, and urine reclamation subsystems were integrated with end-use equipment items and successfully operated in open and partially closed-loop modes, with man-in-the-loop, for a total of 28 days. Several significant subsystem physical anomalies were encountered during testing. Reclaimed potable and hygiene water generally met the current Space Station Freedom (SSF) water quality specifications for inorganic and microbiological constituents, but exceeded the maximum allowable concentrations for Total Organic Carbon (TOC). This paper summarizes the test objectives, system design, test activities/protocols, significant results/anomalies, and major lessons learned. Author

A92-31359* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE CHARACTERIZATION OF ORGANIC CONTAMINANTS DURING THE DEVELOPMENT OF THE SPACE STATION WATER RECLAMATION AND MANAGEMENT SYSTEM
H. COLE, M. HABERCOM, M. CRENSHAW, S. JOHNSON, S. MANUEL, W. MARTINDALE, G. WHITMAN (Boeing Co., Missiles and Space Div., Huntsville, AL), and M. TRAWEEK (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 75-106. refs
(SAE PAPER 911376) Copyright

Examples of the application of various methods for characterizing samples for alcohols, fatty acids, detergents, and volatile/semivolatile basic, neutral, and phenolic acid contaminants are presented. Data, applications, and interpretations are given for a variety of methods including sample preparation/cleanup procedures, ion chromatography, and gas chromatography with various detectors. Summaries of the major organic contaminants that contribute to the total organic carbon content are presented. R.E.P.

A92-31360* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MICROBIAL DISTRIBUTION IN THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM WATER RECOVERY TEST CONDUCTED AT NASA, MSFC
J. J. GAUTHIER (Alabama, University, Birmingham), M. C. ROMAN (NASA, Marshall Space Flight Center, Huntsville, AL), B. A. KILGORE, T. L. HUFF, D. C. OBENHUBER, D. W. TERRELL (NASA, Marshall Space Flight Center; Sverdrup Technology, Inc., Huntsville, AL), M. E. WILSON, and N. E. JACKSON (Boeing Co., Missiles and Space Div., Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 107-120. refs
(SAE PAPER 911377) Copyright

NASA/MSFC is developing a physical/chemical treatment system to reclaim wastewater for reuse on Space Station Freedom (SSF). Integrated testing of hygiene and potable water subsystems assessed the capability to reclaim water to SSF specifications. The test was conducted from May through July 1990 with a total of 47 days of system test operation. Water samples were analyzed using standard cultural methods employing membrane filtration and spread plate techniques and epifluorescence microscopy. Fatty acid methyl ester and biochemical profiles were used for microbial identification. Analysis of waste and product water produced by the subsystems demonstrated the effective reduction of viable microbial populations greater than 8.0E + 06 colony forming units (CFU) per 100 mL to an average of 5 CFU/100 mL prior to distribution into storage tanks. Author

A92-31361* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MICROBIAL BIOFILM STUDIES OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM WATER RECOVERY TEST FOR SPACE STATION FREEDOM
D. C. OBENHUBER, T. L. HUFF (NASA, Marshall Space Flight Center; Sverdrup Technology, Inc., Huntsville, AL), and E. B. RODGERS (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 121-125. refs
(SAE PAPER 911378) Copyright

Analysis of biofilm accumulation, studies of iodine disinfection of biofilm, and the potential for microbially influenced corrosion in the water recovery test (WRT) are presented. The analysis of WRT components showed the presence of biofilms and organic deposits in selected tubing. Water samples from the WRT contained sulfate-reducing and acid-producing organisms implicated in corrosion processes. Corrosion of an aluminum alloy was accelerated in the presence of these water samples, but stainless steel corrosion rates were not accelerated. R.E.P.

A92-31362* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION FREEDOM ENVIRONMENTAL DATABASE SYSTEM (FEDS) FOR MSFC TESTING
GAIL S. STORY (NASA, Marshall Space Flight Center; Sverdrup Technology, Inc., Huntsville, AL), WENDY WILLIAMS (NASA, Marshall Space Flight Center, Huntsville, AL), and CHARLES CHIU (ION Systems, Inc., Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July

15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 127-140. refs
(SAE PAPER 911379) Copyright

The Water Recovery Test (WRT) at Marshall Space Flight Center (MSFC) is the first demonstration of integrated water recovery systems for potable and hygiene water reuse as envisioned for Space Station Freedom (SSF). In order to satisfy the safety and health requirements placed on the SSF program and facilitate test data assessment, an extensive laboratory analysis database was established to provide a central archive and data retrieval function. The database is required to store analysis results for physical, chemical, and microbial parameters measured from water, air and surface samples collected at various locations throughout the test facility. The Oracle Relational Database Management System (RDBMS) was utilized to implement a secured on-line information system with the ECLSS WRT program as the foundation for this system. The database is supported on a VAX/VMS 8810 series mainframe and is accessible from the Marshall Information Network System (MINS). This paper summarizes the database requirements, system design, interfaces, and future enhancements. Author

A92-31363* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION FREEDOM WATER RECOVERY TEST TOTAL ORGANIC CARBON ACCOUNTABILITY
MICHAEL W. DAVIDSON (ION Systems, Inc., Huntsville, AL), LAURENCE SLIVON (Battelle Memorial Institute, Columbus, OH), LINDA SHELDON (Research Triangle Institute, Research Triangle Park, NC), and MARY TRAWEEK (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 141-159. refs
(SAE PAPER 911380) Copyright

Marshall Space Flight Center's (MSFC) Water Recovery Test (WRT) addresses the concept of integrated hygiene and potable reuse water recovery systems baselined for Space Station Freedom (SSF). To assess the adequacy of water recovery system designs and the conformance of reclaimed water quality to established specifications, MSFC has initiated an extensive water characterization program. MSFC's goal is to quantitatively account for a large percentage of organic compounds present in waste and reclaimed hygiene and potable waters from the WRT and in humidity condensate from Spacelab missions. The program is coordinated into Phase A and B. Phase A's focus is qualitative and semi-quantitative. Precise quantitative analyses are not emphasized. Phase B's focus centers on a near complete quantitative characterization of all water types. Technical approaches along with Phase A and partial Phase B investigations on the compositional analysis of Total Organic Carbon (TOC) Accountability are presented. Author

A92-31364
SYSTEM STERILIZATION FOR SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM, WATER RECOVERY TEST
RAYMOND F. PARHAM and TONY R. TIPPS (Micro Craft, Inc., Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 161-193. refs
(SAE PAPER 911381) Copyright

This paper addresses the methods, procedures, and results of the system sterilization associated with the Environmental Control and Life Support System Phase III, Water Recovery Test, Stages 1A/2A/3A, which took place at the Marshall Space Flight Center, Huntsville, Alabama. Sterilization was required for several purposes in this test: to provide a microbially free baseline in the test bed for evaluation of the Environmental Control and Life Support System water recovery design, to recover any portion of the system in the event of a microbial upset, and to provide a source of facility water to be used by test subjects for showers and handwashes. Typical components in the system include tubing, water storage tanks, pumps, valves, instrumentation, heat exchangers, and sample ports. Author

A92-31365* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION FREEDOM ECLSS DESIGN CONFIGURATION - A POST RESTRUCTURE UPDATE
ALLEN S. BACSKAY (NASA, Marshall Space Flight Center, Huntsville, AL) and ROBERT C. DALEE (McDonnell Douglas Space Systems Co., Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 195-212. refs
(SAE PAPER 911414) Copyright

The Space Station Freedom Program (SSFP) has undergone major design changes within the last year due to reduced budget appropriations imposed by Congress. This paper outlines the impacts of the design changes on the Environmental Control and Life Support System (ECLSS), with emphasis on the system aspects of the ECLSS. Brief descriptions of design impacts to all six ECLSS subsystems are provided in addition to interactions with other distributed systems such as Data Management, Electrical Power, and Man Systems. The assembly sequence for SSF is addressed with emphasis on key flights with respect to the ECLSS. Author

A92-31366* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ECLSS REGENERATIVE SYSTEMS COMPARATIVE TESTING AND SUBSYSTEM SELECTION
ROBYN L. CARASQUILLO, DONALD L. CARTER, DONALD W. HOLDER, JR., CINDY F. MCGRIFF, and KATHRYN Y. OGLE (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 213-228.
(SAE PAPER 911415) Copyright

In support of Space Station Freedom Phase C/D Environmental Control and Life Support Systems (ECLSS) regenerative systems development, comparative testing was performed on predevelopment hardware of competing technologies for each regenerative function. The purpose of the test program was to collect data on latest generation hardware in order to make final technology selections for each subassembly in the oxygen recovery and water reclamation strings. This paper discusses the testing performed, test results, and evaluation of these results relative to subsystem selections for CO2 reduction, O2 generation, potable water processing, hygiene water processing, and urine processing. Author

A92-31367* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
WASTE WATER PROCESSING TECHNOLOGY FOR SPACE STATION FREEDOM - COMPARATIVE TEST DATA ANALYSIS
JANIE H. MIERNIK, BURT H. SHAH (Boeing Defense and Space Group, Huntsville, AL), and CINDY F. MCGRIFF (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 229-240. refs
(SAE PAPER 911416) Copyright

Comparative tests were conducted to choose the optimum technology for waste water processing on SSF. A thermoelectric integrated membrane evaporation (TIMES) subsystem and a vapor compression distillation subsystem (VCD) were built and tested to compare urine processing capability. Water quality, performance, and specific energy were compared for conceptual designs intended to function as part of the water recovery and management

system of SSF. The VCD is considered the most mature and efficient technology and was selected to replace the TIMES as the baseline urine processor for SSF. R.E.P.

A92-31368
MASS BALANCE SENSITIVITY FOR SPACE STATION FREEDOM - CLOSED LOOP LIFE SUPPORT
JANIE H. MIERNIK and DAVID L. BAER-PECKHAM (Boeing Defense and Space Group, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 241-252. refs
(SAE PAPER 911417) Copyright

Mass balance for atmosphere, water and solids pertaining to Environmental and Life Support Systems (ECLSS) on SSF has been modeled on a Lotus 123 spreadsheet. Parameters are varied to analyze the sensitivity of the mass balance to various hardware combinations, metabolic rates and crew configurations. This program has been utilized to estimate system integration, capacity and tank sizing of ECLSS hardware. ECLSS will provide optimization and flexibility of water management to minimize or eliminate the necessity to vent water or other fluids in the vicinity of SSF. R.E.P.

A92-31369
OPTIMIZATION OF THE BOSCH CO2 REDUCTION PROCESS
CHARLES T. BUNNELL, ROBERT B. BOYDA, and M. G. LEE (Life Systems, Inc., Cleveland, OH) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 253-259. refs
(SAE PAPER 911451) Copyright

Extensive development testing to support the design of the SSF Carbon Dioxide Reduction Assembly (CReA) has been conducted. Both dual and single reactor eight-person capacity systems, supported by experimental test setups, have been used to broaden the design data base. Multiple catalysts were evaluated. Of significant importance was data that showed that operation of the Bosch reaction at elevated pressure 150-205 kPa (7-15 psig) provides significant increases in process efficiency. These improvements significantly reduce the recycle gas rate necessary to achieve a 99 percent + CO2 reduction efficiency. Data presented illustrates the improvements realized and defines the benefits that the new technology offers in terms of savings in power, weight and volume as illustrated by the SSF CReA. Author

A92-31370
SPE WATER ELECTROLYZERS FOR CLOSED ENVIRONMENT LIFE SUPPORT
J. F. MCELROY, T. M. MOLTER, and R. J. ROY (Hamilton Standard, Windsor Locks, CT) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 261-270.
(SAE PAPER 911453) Copyright

A review is presented of the research and development of the SPE water electrolyzer project that evolved from a fuel cell project when the first chemically stable, long life, perfluorocarbon ion exchange membranes became available. The system design features microgravity liquid/gas static phase separators and the utilization of processed hygiene water as the feedstock. A top level system schematic is given along with details of the static phase separators and a summary of overall electrolyzer performance. R.E.P.

A92-31371
AN ASSESSMENT OF THE READINESS OF VAPOR COMPRESSION DISTILLATION FOR SPACECRAFT WASTEWATER PROCESSING
LAWRENCE D. NOBLE, JR., FRANZ H. SCHUBERT, REX E. GRAVES (Life Systems, Inc., Cleveland, OH), and JANIE H. MIERNIK (Boeing Defense and Space Group, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 271-282. refs
(SAE PAPER 911454) Copyright

Exhaustive testing and analysis of Vapor Compression Distillation technology has proven its overall readiness as a wastewater processor for the recovery of water in orbiting and interplanetary spacecraft. In conjunction with Boeing Aerospace and Electronics and the National Aeronautics and Space Administration, Life Systems' technical team has been focusing on verifying and improving performance characteristics, microgravity compatibility, reliability and maintainability aspects of the Vapor Compression Distillation design. Amassing thousands of hours of testing and recent breakthroughs in the area of peristaltic pump design, product water conductivity sensing and gas/liquid separation concepts have substantially increased the engineering and scientific database that has been accumulating over the past 29 years. Boeing Aerospace and Electronics recently selected the Vapor Compression Distillation concept as baseline for water reclamation via urine processing for the Space Station Freedom, indicating that Vapor Compression Distillation will be a key to providing wastewater regeneration essential for long-term human survival in space. Author

A92-31372
SHOWER WATER RECOVERY BY UF/RO
DOUG SNOWDON (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 283-287. refs
(SAE PAPER 911455) Copyright

An ultrafiltration/reverse osmosis (UF/RO) membrane breadboard system is presented. The purpose of this breadboard UF/RO testing was to demonstrate the chemical performance of the membranes when processing actual shower water. It is shown that although the system suffered degradation in hydraulic performance during the system testing, the resultant permeate consistently demonstrated a total organic compound of less than 10 ppm. R.E.P.

A92-31373* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LEAK DETECTION OF THE SPACE STATION FREEDOM U.S. LAB VACUUM SYSTEM USING REVERSE FLOW LEAK DETECTION METHODOLOGY
JEFFREY D. MOORE, JAMES E. SHEPHERD, and DARRELL E. MASDEN (Teledyne Brown Engineering, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 289-295. Research supported by NASA. refs
(SAE PAPER 911456) Copyright

A vacuum system leak detection technique (reverse flow leak detection) under development for use aboard Space Station Freedom is presented. The technique will be applied to the Vacuum System (VS) and Waste Gas Management Subsystem (WGMS) of the U.S. Lab Module. These two systems contain over 45.7 m of distributed vacuum tubing located in remote utility runs. Fluid flow calculations which utilize known system geometry and measured steady state pressure measurements from the VS and WGMS can be used to identify leak sites within +/- 38 cm. Exact leak position can then be pinpointed by conventional tracer gas leak detection in the identified region. Tests have been performed using a simple, unrestricted 12.8 m length of vacuum tubing with a calibrated air leak attached. Author

A92-31374
MATHEMATICAL MODELLING OF A FOUR-BED MOLECULAR SIEVE WITH CO2 AND H2O COLLECTION
R. S. BARKER, M. R. RUSSELL, and L. R. WHITMER (Boeing Aerospace and Electronics, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 297-313. refs
(SAE PAPER 911470) Copyright

An analytical model of the Four-Bed Molecular Sieve (4BMS) proposed for SSF is described. Attention is given to the system description, carbon dioxide removal assembly performance requirements, the 4BMS subsystem, the vacuum pump model, and the molecular sieve bed model. Representative plotted transient performance data for the baseline 4BMS are presented. It is shown that a simple control logic scheme will maintain the CO2 accumulator pressure within a satisfactory operating range, and the dessicant bed nearly breaks through at the specified maximum normal operation inlet dewpoint. R.E.P.

A92-31375* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
HYDRAULIC MODEL OF THE PROPOSED WATER RECOVERY AND MANAGEMENT SYSTEM FOR SPACE STATION FREEDOM
CHARLES E. MARTIN (McDonnell Douglas Space Systems Co., Huntsville, AL) and ALLEN S. BACSKAY (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 315-335. refs
(SAE PAPER 911472) Copyright

A model of the Water Recovery and Management (WRM) system utilizing SINDA '85/FLUINT to determine its hydraulic operation characteristics, and to verify the design flow and pressure drop parameters is presented. The FLUINT analysis package is employed in the model to determine the flow and pressure characteristics when each of the different loop components is operational and contributing to the overall flow pattern. The water is driven in each loop by storage tanks pressurized with cabin air, and is routed through the system to the desired destination. R.E.P.

A92-31376* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEVELOPING REAL-TIME CONTROL SOFTWARE FOR SPACE STATION FREEDOM CARBON DIOXIDE REMOVAL
STEVEN A. ROWE, ALEXANDER R. MORANDO (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., Torrance, CA), and JIM JOHNSON (Boeing Defense and Space Group, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 337-352. refs
(Contract NAS8-50000)
(SAE PAPER 911418) Copyright

This paper presents AiResearch experience to date in using the NASA/Boeing Application Generator (AG) to develop real-time control systems for the Carbon Dioxide Removal Assembly (CDRA) in Work Package 01. The AG provides an integrated design and development tool encompassing: system analysis, modeling, control law design, simulation, code generation, real-time hardware-in-the-loop simulation and operation, and documentation. This allows rapid interactive prototyping of real-time control systems in a single, integrated, environment. Advantages and disadvantages of using the AG for real-time control system development will be addressed, with the CDRA specification to delivery cycle serving as a basis for discussion. Suggestions for improving the AG are offered and observations on its potential as a top-level system specification tool are made. Author

A92-31377
DEVELOPMENT OF A G189A MODEL OF THE SPACE STATION FREEDOM ATMOSPHERE
R. S. BARKER and R. G. VON JOUANNE (Boeing Defense and Space Group, Huntsville, AL) IN: Space Station ECLSS and thermal control; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 353-359. refs
(SAE PAPER 911469) Copyright

An advanced ECLSS Model has been developed using the G189A Environmental/Thermal Control and Life Support Systems Computer Program for simulating the atmospheric conditions on board Space Station Freedom. Significant changes have been applied to the previous model which allow for refined atmospheric simulation, while retaining the overall objective of avoiding rigorous models of individual components. The highlights of the advanced atmospheric model center around the intermodule linkage and ventilation, and the Atmosphere Revitalization System. Progressive techniques employed in the present model include the following: (1) segregation of the open cabin air from the air volume within racks and standoffs, with an approximate air exchange rate between the two volumes (in each Freedom element); (2) refinement of the Four Bed Molecular Sieve (4BMS) modeling technique, such that the effects upon the Freedom atmosphere are essentially identical to those experienced with an actual cycling 4BMS (while still retaining a simple steady-state black box for modeling 4BMS operations; and (3) the tracking of the cumulative CO2 exposure to which every individual crewmember is subjected during every mission day, as dictated by that person's work schedule and location within the Freedom elements (including the international elements). Author

A92-31378
REGENERATIVE LIFE SUPPORT SYSTEMS AND PROCESSES; PROCEEDINGS OF THE 21ST INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SYSTEMS, SAN FRANCISCO, CA, JULY 15-18, 1991
Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-873), 1991, 197 p. For individual items see A92-31379 to A92-31398.
(SAE SP-873; ISBN 1-56091-153-0) Copyright

The present volume discusses controlled ecological life support systems (CELSS) design considerations, the evolutionary development of a lunar CELSS, regenerative life support system (RLSS) performance, iodine-based microbial control of a hydroponic nutrient solution, RLSSs for space exploration, water vapor recovery for plant-growth chambers, and advanced air revitalization systems for optimized crew and plant environments. Also discussed are trace hydrocarbon contaminant removal from recycled water via biological reactors, advancements in immobilized enzyme reactors, a proton-exchange membrane electrochemically-reclaimed water posttreatment system, catalytic oxidation of closed life support systems' waste streams, Sabatier CO2 reduction for long-duration manned spaceflights, and the RLSS testbed at NASA-Johnson. O.C.

A92-31379* National Aeronautics and Space Administration, Washington, DC.
BIOREGENERATIVE LIFE SUPPORT - THE INITIAL CELSS REFERENCE CONFIGURATION
JOHN D. RUMMEL and MEL AVERNER (NASA, Life Sciences Div., Washington, DC) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 1-5.
(SAE PAPER 911420) Copyright

The next major step in the development of an operational Controlled Ecological Life-Support System (CELSS) is the creation of a human-rated ground-based demonstrator able to constitute a CELSS's proof-of-concept. The reference configuration recently devised for such a ground facility by NASA will furnish a common

reference to all investigators in the field, thereby facilitating performance comparisons among candidate subsystems and clarifying system-level modeling. A detailed NASA reference CELSS flowcharting is presented. O.C.

A92-31380* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVOLUTIONARY DEVELOPMENT OF A LUNAR CELSS
STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) and MARIANN F. BROWN (NASA, Johnson Space Center, Houston, TX) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 7-14. refs
(SAE PAPER 911422) Copyright

An evolutionary technology-integration process has been applied to a baseline, partially-closed regenerative life support system (LSS) based on Space Station Freedom-typified physicochemical (PC) technology; the result of this evolution is the Lunar-base Controlled Ecological LSS (LCELSS), which is a hybrid system incorporating both bioregenerative (BR) and PC technologies. The evolution of the LCELSS has proceeded through a sequence of additions involving (1) bioregenerative functions, (2) supplementing specific PC functions with BR ones, (3) replacement of initial PC technologies with more advanced ones, and (4) the addition of new PC technologies. O.C.

A92-31381* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OPTIONS FOR TRANSPIRATION WATER REMOVAL IN A CROP GROWTH SYSTEM UNDER ZERO GRAVITY CONDITIONS
C. C. BLACKWELL (NASA, Ames Research Center, Moffett Field, CA; Texas, University, Arlington), M. KLISS, B. YENDLER (NASA, Ames Research Center, Moffett Field, CA), B. BORCHERS (Bionetics Corp., Cocoa Beach, FL), BORIS S. YENDLER, THOI K. NGUYEN, and AHMAD WALEH (Applied Sciences Consultants, Inc., San Jose, CA) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 15-18.
(SAE PAPER 911423) Copyright

The operation of a microgravity crop-growth system is a critical feature of NASA's Closed Ecological Life Support System (CELSS) development program. Transpiration-evolved water must be removed from the air that is recirculated in such a system, perhaps supplying potable water in the process. The present consideration of candidate systems for CELSS water removal gives attention to energy considerations and to a mechanical, inertial-operation water-separation system that was chosen due to the depth of current understanding of its operation. O.C.

A92-31382* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DIET EXPERT SUBSYSTEM FOR CELSS
BORIS S. YENDLER (NASA, Ames Research Center, Moffett Field; Applied Sciences Consultants, Inc., San Jose, CA), THOI K. NGUYEN, and AHMAD WALEH (Applied Sciences Consultants, Inc., San Jose, CA) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 19-27. refs
(Contract NAS2-12991; NAS2-13260)
(SAE PAPER 911424) Copyright

An account is given of the mathematical basis of a diet-controlling expert system, designated 'Ceres' for the human crews of a Controlled Ecological Life Support System (CELSS). The Ceres methodology can furnish both steady-state and dynamic diet solutions; the differences between Ceres and a conventional nutritional-modeling method is illustrated by the case of a three-component, potato-wheat-soybean food system. Attention is given to the role of food processing in furnishing flexibility in diet-planning management. Crew diet solutions based on simple optimizations are not necessarily the most suitable for optimum CELSS operation. O.C.

A92-31383* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REGENERATIVE LIFE SUPPORT SYSTEMS (RLSS) TEST BED PERFORMANCE - CHARACTERIZATION OF PLANT PERFORMANCE IN A CONTROLLED ATMOSPHERE
MARYBETH EDEEN and DONALD HENNINGER (NASA, Johnson Space Center, Houston, TX) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 29-34.
(SAE PAPER 911426) Copyright

By growing higher plants for food, lunar and Martian manned habitats will not only reduce resupply requirements but obtain CO2 removal and both oxygen-production and water-reclamation requirements. Plants have been grown in the RLSS at NASA-Johnson in order to quantitatively evaluate plant CO2 accumulation, O2 generation, evapotranspiration, trace-contaminant generation, and biomass productivity. Attention is presently given to test conditions and anomalies in these RLSS trials; areas where performance must be improved have been identified. O.C.

A92-31384* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
MICROBIOLOGICAL CHARACTERIZATION OF THE BIOMASS PRODUCTION CHAMBER DURING HYDROPONIC GROWTH OF CROPS AT THE CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM (CELSS) BREADBOARD FACILITY
RICHARD F. STRAYER (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 35-48. refs
(SAE PAPER 911427) Copyright

A92-31385
IODINE MICROBIAL CONTROL OF HYDROPONIC NUTRIENT SOLUTION
TIMOTHY L. STROUP, STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA), and GEORGE L. MARCHIN (Kansas State University, Manhattan) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 49-52. refs
(SAE PAPER 911490) Copyright

Experimental results are presented which demonstrate the substantial reduction of microbial contamination of hydroponic nutrient solutions by means of the addition of either a triiodide resin or pentaiodide; these treatments respectively reduced leaf lettuce plant fresh weights by 0.2 and 0.04 percent, relative to control plants. Because neuron-activation tissue analysis indicated iodide concentrations of 0.47-0.6 percent in experimental plants, these resins should not be used alone in conjunction with plant-growth systems. O.C.

A92-31386
A CANOPY MODEL FOR PLANT GROWTH WITHIN A GROWTH CHAMBER - MASS AND RADIATION BALANCE FOR THE ABOVE GROUND PORTION
ROBERT L. HEATH (California, University, Riverside) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of

Automotive Engineers, Inc., 1991, p. 53-65. Research supported by McDonnell Douglas Space Systems Co. refs
(SAE PAPER 911494) Copyright

A generalized plant-growth model is developed that encompasses, in addition to mass transfer of gases, radiation/heat balance, and photosynthetic carbohydrate production, the interactions of layers of leaf layers which differentially absorb radiation and gases. Energy balances are used to calculate gas-exchange patterns, and carbohydrate production is derived from light intensity and CO2/O2 concentrations. Productivity is then divided into respiration growth, maintenance storage, structural growth, and export to other growing plant portions. O.C.

A92-31387
ADVANCED REGENERATIVE LIFE SUPPORT FOR SPACE EXPLORATION
H. T. COUCH, J. W. AUMAN, JR., and T. C. FALVEY (Hamilton Standard, Windsor Locks, CT) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 67-77. refs
(SAE PAPER 911500) Copyright

An evaluation is conducted of regenerative Environmental Control and Life Support System technologies promising mass reductions in LEO for long range exploration spacecraft missions, with attention to in situ resource utilization and closed ecological life support system features. Advanced technological development recommendations are made for higher-efficiency urine processing, single-processing methods for both potable and hygiene water, electrolytic oxygen and potable water recovery, chemical N2 storage, and membrane gas separation processes, on the basis of projected expendable, consumable, and installed subsystem LEO mass savings. O.C.

A92-31388* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ADVANCED AIR REVITALIZATION FOR OPTIMIZED CREW AND PLANT ENVIRONMENTS
M. G. LEE, DAVID J. GRIGGER (Life Systems, Inc., Cleveland, OH), and MARIANN F. BROWN (NASA, Johnson Space Center, Houston, TX) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 79-87. refs
(Contract NAS9-17913)
(SAE PAPER 911501) Copyright

The Hybrid Air Revitalization System (HARS) closed ecosystem concept presented encompasses electrochemical CO2 and O2 separators, in conjunction with a mechanical condenser/separator for maintaining CO2, O2, and humidity levels in crew and plant habitats at optimal conditions. HARS requires no expendables, and allows flexible process control on the bases of electrochemical cell current, temperature, and airflow rate variations. HARS capacity can be easily increased through the incorporation of additional chemical cells. Detailed system flowcharts are provided. O.C.

A92-31389* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
WATER VAPOR RECOVERY FROM PLANT GROWTH CHAMBERS
R. J. RAY, D. D. NEWBOLD, R. H. COLTON, and S. B. MCCRAY (Bend Research, Inc., OR) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 89-97. refs
(Contract NAS2-13345)
(SAE PAPER 911502) Copyright

NASA is investigating the use of plant growth chambers (PGCs) for space missions and for bases on the moon and Mars. Key to successful development of PGCs is a system to recover and reuse the water vapor that is transpired from the leaves of the plants. A design is presented for a simple, reliable, membrane-based system that allows the recovery, purification, and reuse of the transpired water vapor through control of temperature and humidity levels in PGCs. The system is based on two membrane technologies: (1) dehumidification membrane modules to remove water vapor from the air, and (2) membrane contactors to return water vapor to the PGC (and, in doing so, to control the humidity and temperature within the PGC). The membrane-based system promises to provide an ideal, stable growth environment for a variety of plants, through a design that minimizes energy usage, volume, and mass, while maximizing simplicity and reliability. Author

A92-31390
USING BIOLOGICAL REACTORS TO REMOVE TRACE HYDROCARBON CONTAMINANTS FROM RECYCLED WATER
GARY P. MILLER, RALPH J. PORTIER, DAVID P. DICKEY (Louisiana State University, Baton Rouge), and HOWARD L. SLEEPER (Lockheed Missiles and Space Co., Inc., Research and Development Div., Palo Alto, CA) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 99-107. Research supported by Lockheed Missiles and Space Co., Inc., NOAA, Louisiana State University, et al. refs
(SAE PAPER 911504) Copyright

The validity of immobilized-bed biological-reactor concepts for the removal of trace contaminants from recycled water is experimentally tested for three groups of target organics, namely aliphatics, aromatics, and chlorinated aliphatics. The experimental results obtained demonstrate the removal of 99.9 percent of the 100 ppm phenol content of a water stream. A 10 ppm phenol-feed stream was reduced to less than 500 ppb using a recycle-mode reactor over a retention time of 13 hours; the same reactor was able to remove over 99.88 percent of the phenol in plug-flow mode. O.C.

A92-31391* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ADVANCED DEVELOPMENT OF IMMOBILIZED ENZYME REACTORS
CLIFFORD D. JOLLY, LEONARD J. SCHUSSEL (Umpqua Research Co., Myrtle Creek, OR), and LAYNE CARTER (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 109-117. refs
(Contract NAS8-38421)
(SAE PAPER 911505) Copyright

Fixed-bed reactors have been used at NASA-Marshall to purify wastewater generated by an end-use equipment facility, on the basis of a combination of multifiltration unibeds and enzyme unibeds. The enzyme beds were found to effectively remove such targeted organics as urea, alcohols, and aldehydes, down to levels lying below detection limits. The enzyme beds were also found to remove organic contaminants not specifically targeted. O.C.

A92-31392 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE USE OF MEMBRANES IN LIFE SUPPORT SYSTEMS FOR LONG-DURATION SPACE MISSIONS
S. B. MCCRAY, R. J. RAY, and D. D. NEWBOLD (Bend Research, Inc., OR) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 119-130. refs
(Contract NAS9-17031; NAS9-17611; NAS9-17581; NAS9-18085; NAS9-18477; NAS2-13345; NAS8-38902)
(SAE PAPER 911537) Copyright

The use of membrane processes in a long-duration manned mission's regenerative environmental control and life-support

system is presently discussed, in the cases of treatment for hygiene water, urine, humidity condensate, and phase-change distillate, as well as of water-vapor and CO2 removal from spacecraft air. Attention is given to the design of a tube-side-feed hollow-fiber module for membrane support and fluids-feed, as well as to the schematics for a membrane-based urine processor, an air recirculator, a potable-water producer, and a two-stage urine treater. O.C.

A92-31393* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF A PROTON-EXCHANGE MEMBRANE ELECTROCHEMICAL RECLAIMED WATER POST-TREATMENT SYSTEM
LAMINE KABA (Texas A & M University, College Station), CHARLES E. VEROSTKO (NASA, Johnson Space Center, Houston, TX), G. D. HITCHENS, and OLIVER J. MURPHY (Lynntech, Inc., Bryan, TX) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 131-140. refs
(Contract NAG9-427)
(SAE PAPER 911538)

A single-cell electrochemical reactor that utilizes a proton exchange membrane (PEM) as a solid electrolyte is being investigated for posttreatment of reclaimed waste waters with low or negligible electrolyte content. Posttreatment is a final 'polishing' of reclaimed waste waters prior to reuse, and involves removing organic impurities at levels as high as 100 ppm to below 500 ppb total organic carbon (TOC) content to provide disinfection. The system does not utilize or produce either expendable hardware components or chemicals and has no moving parts. Test data and kinetic analysis are presented. The feasibility and application for water reclamation processes in controlled ecological environments (e.g., lunar/Mars habitats) are also presented. Test results show that the electrochemical single cell reactor provides effective posttreatment. Author

A92-31394* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CATALYTIC OXIDATION FOR TREATMENT OF ECLSS AND PMMS WASTE STREAMS
JAMES R. AKSE and CLIFFORD D. JOLLY (Umpqua Research Co., Myrtle Creek, OR) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 141-150. refs
(Contract NAS8-38038; NAS8-38490)
(SAE PAPER 911539)

It is shown that catalytic oxidation is an effective technique for the removal of trace organic contaminants in a multifiltration potable processor's effluent. Essential elements of this technology are devices that deliver oxygen to the influent, and remove gaseous reaction byproducts from the effluent, via hollow-tube, gas-permeable membranes. Iodine, which poisons existing catalysis, is removed by a small deiodination bed prior to catalytic reactor entrance. The catalyst used is a mixture of Pt and Ru deposited on carbon, operating at 125-160 C and 39-90 psi pressures. O.C.

A92-31395* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AIRBORNE TRACE ORGANIC CONTAMINANT REMOVAL USING THERMALLY REGENERABLE MULTI-MEDIA LAYERED SORBENTS
JAMES E. ATWATER and JOHN T. HOLTSNIDER (Umpqua Research Co., Myrtle Creek, OR) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 151-158. refs
(Contract NAS9-18337)
(SAE PAPER 911540)

A cyclic two-step process is described which forms the basis for a simple and highly efficient air purification technology. Low molecular weight organic vapors are removed from contaminated airstreams by passage through an optimized sequence of sorbent media layers. The contaminant loaded sorbents are subsequently regenerated by thermal desorption into a low volume inert gas environment. A mixture of airborne organic contaminants consisting of acetone, 2-butanone, ethyl acetate, Freon-113 and methyl chloroform has been quantitatively removed from breathing quality air using this technique. The airborne concentrations of all contaminants have been reduced from initial Spacecraft Maximum Allowable Concentration (SMAC) levels to below the analytical limits of detection. No change in sorption efficiency was observed through multiple cycles of contaminant loading and sorbent regeneration via thermal desorption. Author

A92-31396
SABATIER CARBON DIOXIDE REDUCTION SYSTEM FOR LONG-DURATION MANNED SPACE APPLICATION
HAL J. STRUMPF, C. Y. CHIN (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., Torrance, CA), GEORGE R. LESTER, and STEPHEN T. HOMEYER (Allied-Signal Aerospace Co., Des Plaines, IL) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 159-170. refs
(SAE PAPER 911541)

A carbon dioxide reduction system is being developed for long-duration manned space missions. The system incorporates a Sabatier methanation reactor, utilizing previously developed catalyst materials, and a hollow fiber membrane unit to separate the products of reaction. Heat produced by the exothermic Sabatier reaction is absorbed by an air stream, which also regulates the reactor temperature to maximize yield. This absorbed heat can be utilized elsewhere in the carbon dioxide management system to reduce power requirements. The Sabatier process combines carbon dioxide and hydrogen to form methane and water. In a manned space environment, the water is then either electrolyzed to form oxygen for breathing and hydrogen to drive the reaction, or recycled to the potable water system. A computer-based performance model using finite elements has been developed to evaluate reactor design and catalyst performance. Laboratory testing of the Sabatier reaction using various catalyst materials is ongoing, with preliminary results reported in this paper. Author

A92-31397* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REGENERATIVE LIFE SUPPORT SYSTEMS (RLSS) TEST BED DEVELOPMENT AT NASA-JOHNSON SPACE CENTER
TERRY O. TRI, MARIANN F. BROWN, MICHAEL K. EWERT, SANDRA L. FOERG (NASA, Johnson Space Center, Houston, TX), and MELISSA K. MCKINLEY (Lockheed Engineering and Sciences Co., Houston, TX) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 171-178.
(SAE PAPER 911425)

NASA-Johnson's RLSS testbed employs higher plants in a closed environment, in conjunction with a physicochemically-based life-support system, to create an integrated, biological-/physicochemical RLSS. Crew presence is simulated by a human metabolic simulator, and operation is sufficiently automated for crops to be grown from seed to harvest without human intervention. Attention is given to the Variable Pressure Growth Chamber, which will be operable at both ambient atmospheric pressures and at the reduced pressures representative of operations in lunar and Martian environments. O.C.

A92-31398
DEVELOPMENT OF IMMOBILIZED CELL BIOREACTOR TECHNOLOGY FOR WATER RECLAMATION IN A REGENERATIVE LIFE SUPPORT SYSTEM
GLENN E. PETRIE (Allied-Signal Aerospace Co., Des Plaines, IL) and MAURENA S. NACHEFF-BENEDICT (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., Torrance, CA) IN: Regenerative life support systems and processes; Proceedings of the 21st International Conference on Environmental Systems, San Francisco, CA, July 15-18, 1991. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 179-191. Research supported by Allied-Signal, Inc. refs
(SAE PAPER 911503) Copyright

The applicability of immobilized microbial cell bioreactor technology to primary water processing in a regenerative life-support system's waste-water streams is presently investigated; such a bioreactor could in principle leave only trace contaminants, whose final removal would then be effected depending on intended water use. Specific microorganisms have been adapted for expected waste stream compositions; these enriched aerobic microorganisms were immobilized in packed-bed reactor configurations that were then operated in a continuous-process mode. Reactor performance is evaluated as a function of reactor vessel geometry, support material, pH, and hydraulic detention time. O.C.

N92-20046# Sandia National Labs., Albuquerque, NM.
SOLAR DETOXIFICATION OF WATER CONTAINING CHLORINATED SOLVENTS AND HEAVY METALS VIA TIO2 PHOTOCATALYSIS
M. R. PRAIRIE, J. PACHECO, and L. R. EVANS 1991 20 p Presented at the 1992 ASME-JSES-KSES International Solar Energy Conference, Maui, HI, 4-8 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE91-018396; SAND-91-1285C; CONF-920436-3) Avail: NTIS HC/MF A03

Researchers around the world have demonstrated the effectiveness of titanium dioxide-based photocatalysis for decontaminating water containing hazardous organics and heavy metals. A great advantage of this process is that the organic is completely destroyed, leaving behind only water, carbon dioxide and dilute mineral acids. Also, the process has potential for doing two decontamination jobs at once: oxidizing organics while reducing toxic metals. As part of a program sponsored by the DOE, Sandia National Laboratories is carrying out large-scale tests to study the solar destruction of organics at realistic processing rates in addition to laboratory work aimed at determining the applicability of solar detoxification to the removal of heavy metals. In this paper, we present up-to-date results from Sandia's effort. The large scale tests illustrate the effectiveness of solar detoxification for a variety of organics and compare measured reaction rates against published values of the rate constants for attack by aqueous hydroxyl radicals. This comparison highlights the importance of hydroxyl radical chemistry in solar detoxification processes. It is concluded that solar detoxification is only feasible for easily destroyed compounds like TCE, and PCE. The chlorinated methanes and ethanes are much more difficult to destroy and require very large solar collectors. In the second part of the paper, laboratory data are presented for a variety of different metals, including Ag, Cd, Cu, Hg, Ni, and Pt. The concentration of dissolved oxygen is one of the variables in the study. It is shown that the presence of dissolved metals can have a profound effect on organic oxidation rate, and that oxygen is not necessarily required for oxidation to occur. It is concluded that solar detoxification would be useful for removing mercury and silver but not for copper, nickel nor cadmium. DOE

N92-20268*# Wisconsin Univ., Milwaukee. Space Architecture Design Group.
SPACE ARCHITECTURE MONOGRAPH SERIES. VOLUME 4: GENESIS 2: ADVANCED LUNAR OUTPOST Final Report
JOSEPH P. FIEBER, JANIS HUEBNER-MOTHS, KERRY L. PARULESKI, and GARY T. MOORE, ed. 11 Jun. 1991 90 p
(Contract NASW-4435)
(NASA-CR-190027; NAS 1.26:190027; R91-2-VOL-4; ISBN-0-938744-74-7) Avail: NTIS HC/MF A05 HC first copy free, additional copies $10.00 CSCL 06K

This research and design study investigated advanced lunar habitats for astronauts and mission specialists on the Earth's moon. Design recommendations are based on environmental response to the lunar environment, human habitability (human factors and environmental behavior research), transportability (structural and materials system with least mass), constructability (minimizing extravehicular time), construction dependability and resilience, and suitability for NASA launch research missions in the 21st century. The recommended design uses lunar lava tubes, with construction being a combination of Space Station Freedom derived hard modules and light weight Kevlar laminate inflatable structures. The proposed habitat includes research labs and a biotron, crew quarters and crew support facility, mission control, health maintenance facility, maintenance work areas for psychological retreat, privacy, and comtemplation. Furniture, specialized equipment, and lighting are included in the analysis and design. Drawings include base master plans, construction sequencing, overall architectural configuration, detailed floor plans, sections and axonometrics, with interior perspectives. Author

N92-20269*# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
THERMAL CONTROL SYSTEMS FOR LOW-TEMPERATURE HEAT REJECTION ON A LUNAR BASE Semiannual Status Report
K. R. SRIDHAR and MATTHIAS GOTTMANN Feb. 1992 35 p
(Contract NAG5-1572)
(NASA-CR-190063; NAS 1.26:190063) Avail: NTIS HC/MF A03 CSCL 06K

One of the important issues in the lunar base architecture is the design of a Thermal Control System (TCS) to reject the low temperature heat from the base. The TCS ensures that the base and all components inside are maintained within the operating temperature range. A significant portion of the total mass of the TCS is due to the radiator. Shading the radiation from the sun and the hot lunar soil could decrease the radiator operating temperature significantly. Heat pumps have been in use for terrestrial applications. To optimize the mass of the heat pump augmented TCS, all promising options have to be evaluated and compared. Careful attention is given to optimizing system operating parameters, working fluids, and component masses. The systems are modeled for full load operation. Author

N92-20430*# Prairie View Agricultural and Mechanical Coll., TX. Dept. of Architecture.
MARS HABITAT
DALE AYERS, TIMOTHY BARNES, WOODY BRYANT, PARVEEN CHOWDHURY, JOE DILLARD, VERNADETTE GARDNER, GEORGE GREGORY, CHERYL HARMON, BROCK HARRELL, SHERRILL HILTON et al. 25 Nov. 1991 52 p
(Contract NASW-4435)
(NASA-CR-189985; NAS 1.26:189985) Avail: NTIS HC/MF A04 CSCL 06K

The objective of this study is to develop a conceptual design for a permanently manned, self-sustaining Martian facility, to accommodate a crew of 20 people. The goal is to incorporate the major functions required for long term habitation in the isolation of a barren planet into a thriving ecosystem. These functions include living, working, service, and medical facilities as well as a green house. The main design task was to focus on the internal layout while investigating the appropriate structure, materials, and construction techniques. The general concept was to create a comfortable, safe living environment for the crew members for a stay of six to twelve months on Mars. Two different concepts were investigated, a modular assembly reusable structure (MARS) designated Lavapolis, and a prefabricated space frame structure called Hexamars. Both models take into account factors such as future expansion, radiation shielding, and ease of assembly. Author

N92-20583*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics and Engineering Science.
DESIGN OF BIOMASS MANAGEMENT SYSTEMS AND COMPONENTS FOR CLOSED LOOP LIFE SUPPORT SYSTEMS Final Report
GALE E. NEVILL, JR. Jun. 1991 197 p
(Contract NASW-4435)
(NASA-CR-190017; NAS 1.26:190017) Avail: NTIS HC/MF A09 CSCL 06K

The design of a biomass management system (BMS) for use in a closed loop support system is presented by University of Florida students as the culmination of two design courses. The report is divided into two appendixes, each presenting the results of one of the design courses. The first appendix discusses the preliminary design of the biomass management system and is subdivided into five subsystems: (1) planting and harvesting, (2) food management, (3) resource recovery, (4) refurbishing, and (5) transport. Each subsystem is investigated for possible solutions to problems, and recommendations and conclusions for an integrated BMS are discussed. The second appendix discusses the specific design of components for the BMS and is divided into three sections: (1) a sectored plant growth unit with support systems, (2) a container and receiving mechanism, and (3) an air curtain system for fugitive particle control. In this section components are designed, fabricated, and tested. H.A.

N92-20982# Army Natick Labs., MA.
HAND ANTHROPOMETRY OF US ARMY PERSONNEL Final Report, 26 Jun. 1989 - 31 Dec. 1990
THOMAS M. GREINER Dec. 1991 425 p
(AD-A244533) Avail: NTIS HC/MF A18 CSCL 05/9

This report presents the results of the analysis of data on the hand gathered during the 1987-1988 anthropometric survey of Army personnel. Data are presented in the form of summary statistics and percentile tables. In addition, correlations, regressions, analyses of variance and principal components for sex and racial groups, nonmetric trait frequencies, and observer error magnitudes are reported. These data summaries are presented for a subset of the actual data base (1003 men and 1304 women) that match the working data bases summarized in the anthropometric survey's final report. Therefore, the hand working data bases match the demographic characteristics of the June 1988 Army, and are comprised of individuals who are in the anthropometric survey's working data bases. The dimensions given in this report include 64 hand measurements that were obtained using a special photometric system. An additional 22 dimensions, obtained through direct measurement during the anthropometric survey, were added to the hand data base. Therefore, a total of 86 dimensions are presented in this report. Measurement descriptions, visual indices, and a glossary are included to aid readers in locating dimensions and in interpreting presentations. GRA

N92-21002# Pacific Northwest Lab., Richland, WA.
EVOLUTION OF THE SOLDIER-MACHINE INTERFACE PROTOTYPE FOR TACTICAL COMMAND AND CONTROL SYSTEMS
S. M. ADAMS and K. D. HARGROVE Nov. 1991 13 p Presented at the Transportable Applications Environment Plus (TAE+) Users Conference, Carrollton, MD, 5-7 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006486; PNL-SA-19902; CONF-9111172-1) Avail: NTIS HC/MF A03

The U.S. Army Tactical Command and Control System (ATCCS) Experimentation Site (AES) was established to support the evolutionary development, integration, and interoperability experimentation on the ATCCS software with emphasis on the Soldier-Machine Interface and human factors. Activities at the AES include exercising a system in an environment designed to assist experiment proponents and material and combat developers to uncover system problems and make corrections prior to the formal test and evaluation. The Human Factors Guidelines for the Army Tactical Command and Control System (ATCCS) Soldier-Machine Interface were developed as a part of and as a result of this experimentation. The experiment software varies in nature, size, and complexity. The experiments include demonstrating computer displays and obtaining human evaluations about the acceptability of the interface screens. Rapid prototyping techniques allow screens to be altered quickly with instant evaluation of the effects of alternatives on user perceptions. Representative issues include colors and terminology, sequencing of items, methods for interactive control, and navigation through displays. DOE

N92-21209*# Texas Univ., Austin. Mechanical Engineering Design Projects Program.
DESIGN OF INTERNAL SUPPORT STRUCTURES FOR AN INFLATABLE LUNAR HABITAT
ELIZABETH A. CAMERON, JOHN A. DUSTON, and DAVID D. LEE 1990 135 p
(Contract NASW-4435)
(NASA-CR-189996; NAS 1.26:189996) Avail: NTIS HC/MF A07 CSCL 06/11

NASA has a long range goal of constructing a fully equipped, manned lunar outpost on the near side of the moon by the year 2015. The proposed outpost includes an inflatable lunar habitat to support crews during missions longer that 12 months. A design for the internal support structures of the inflatable habitat is presented. The design solution includes material selection, substructure design, assembly plan development, and concept scale model construction. Alternate designs and design solutions for each component of the design are discussed. Alternate materials include aluminum, titanium, and reinforced polymers. Vertical support alternates include column systems, truss systems, suspension systems, and lunar lander supports. Horizontal alternates include beams, trusses, floor/truss systems, and expandable trusses. Feasibility studies on each alternate showed that truss systems and expandable trusses were the most feasible candidates for conceptual design. The team based the designs on the properties of 7075 T73 aluminum. The substructure assembly plan, minimizes assembly time and allows crews to construct the habitat without the use of EVA suits. In addition to the design solutions, the report gives conclusions and recommendations for further study of the inflatable habitat design. Author

N92-21243*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
A LUNAR BASE REFERENCE MISSION FOR THE PHASED IMPLEMENTATION OF BIOREGENERATIVE LIFE SUPPORT SYSTEM COMPONENTS Final Report
LAURA N. DITTMER, MICHAEL E. DREWS, SEAN K. LINEAWEAVER, DEREK E. SHIPLEY, and A. HOEHN 18 Jun. 1991 169 p
(Contract NASW-4435)
(NASA-CR-189973; NAS 1.26:189973) Avail: NTIS HC/MF A08 CSCL 06/11

Previous design efforts of a cost effective and reliable regenerative life support system (RLSS) provided the foundation for the characterization of organisms or 'biological processors' in engineering terms and a methodology was developed for their integration into an engineered ecological LSS in order to minimize the mass flow imbalances between consumers and producers. These techniques for the design and the evaluation of bioregenerative LSS have now been integrated into a lunar base reference mission, emphasizing the phased implementation of components of such a BLSS. In parallel, a designers handbook was compiled from knowledge and experience gained during past design projects to aid in the design and planning of future space missions requiring advanced RLSS technologies. The lunar base reference mission addresses in particular the phased implementation and integration of BLS parts and includes the resulting infrastructure burdens and needs such as mass, power, volume, and structural requirements of the LSS. Also, operational aspects such as manpower requirements and the possible need and application of 'robotics' were addressed. Author

N92-21246*# Kansas State Univ., Manhattan. Dept. of Mechanical Engineering.
AUTOMATION OF CLOSED ENVIRONMENTS IN SPACE FOR HUMAN COMFORT AND SAFETY Report, for Academic Year 1990-1991
25 Nov. 1991 156 p
(Contract NASW-4435)
(NASA-CR-190016; NAS 1.26:190016) Avail: NTIS HC/MF A08 CSCL 06/11

The results of the second year of a three year design project on the automation of the Environmental Control and Life Support System (ECLSS) of the Space Station Freedom (SSF) are presented. The results are applicable to other space missions that require long duration space habitats. A description of conceptual controls which are developed for the Water Recovery and Management (WRM) Subassembly is given. Mathematical modeling of the Air Revitalization (AR) Subassembly is presented. The work done by the Kansas State University NASA/USRA interdisciplinary student design team is concluded with a discussion of the expert system which was developed for the AR Subassembly. Author

N92-21272*# Mary Hardin-Baylor Univ., Belton, TX. Dept. of Mathematics and Physics.
CLOSED-LOOP HABITATION AIR REVITALIZATION MODEL FOR REGENERATIVE LIFE SUPPORT SYSTEMS Final Report
MAXWELL M. HART *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 1 15 p Dec. 1991
Avail: NTIS HC/MF A13 CSCL 05/8

The primary function of any life support system is to keep the crew alive by providing breathable air, potable water, edible food, and for disposal of waste. In a well-balanced or regenerative life support system, the various components are each using what is available and producing what is needed by other components so that there will always be enough chemicals in the form in which they are needed. Humans are not just users, but also one of the participating parts of the system. If a system could continuously recycle the original chemicals, this would make it virtually a Closed-loop Habitation (CH). Some difficulties in trying to create a miniature version of a CH are briefly discussed. In a miniature CH, a minimal structure must be provided and the difference must be made up by artificial parts such as physicochemical systems that perform the conversions that the Earth can achieve naturally. To study the interactions of these parts, a computer model was designed that simulates a miniature CH with emphasis on the air revitalization part. It is called the Closed-loop Habitation Air Revitalization Model (CHARM). Author

N92-21309*# Wisconsin Univ., Milwaukee. Dept. of Health Sciences.
THE DOUBLY LABELED WATER METHOD FOR MEASURING HUMAN ENERGY EXPENDITURE: ADAPTATIONS FOR SPACEFLIGHT Final Report
LESLIE O. SCHULZ *In* Texas A and M Univ., NASA/ASEE Summer Faculty Fellowship Program, 1991, Volume 2 7 p Dec. 1991
Avail: NTIS HC/MF A09 CSCL 05/8

It is essential to determine human energy requirements in space, and the doubly labeled water method has been identified as the most appropriate means of indirect calorimetry to meet this need. The method employs naturally occurring, stable isotopes of hydrogen (H-2, deuterium) and oxygen (O-18) which, after dosing, mix with body water. The deuterium is lost from the body as water while the O-18 is eliminated as both water and CO2. The difference between the two isotope elimination rates is therefore a measure of CO2 production and hence energy expenditure. Spaceflight will present a unique challenge to the application of the doubly labeled water method. Specifically, interpretation of doubly labeled water results assumes that the natural abundance or 'background' levels of the isotopes remain constant during the measurement interval. To address this issue, an equilibration model will be developed in an ongoing ground-based study. As energy requirements of women matched to counterparts in the Astronauts Corps are being determined by doubly labeled water, the baseline isotope concentration will be changed by consumption of 'simulated Shuttle water' which is artificially enriched. One group of subjects will be equilibrated on simulated Shuttle water prior to energy determinations by doubly labeled water while the others will consume simulated Shuttle water after dosing. This process will allow us to derive a prediction equation to mathematically model the effect of changing background isotope concentrations. Author

N92-21345*# Southwest Research Inst., San Antonio, TX.
INVESTIGATION OF POSSIBLE CAUSES FOR HUMAN-PERFORMANCE DEGRADATION DURING MICROGRAVITY FLIGHT Final Report, 17 Jan. - 30 Nov. 1991
JAMES E. SCHROEDER and MEGAN L. TUTTLE 26 Mar. 1992 223 p Original contains color illustrations
(Contract NAG9-487; SWRI PROJ. 12-4075)
(NASA-CR-190114; NAS 1.26:190114) Avail: NTIS HC/MF A10; 1 functional color page CSCL 05/8

The results of the first year of a three year study of the effects of microgravity on human performance are given. Test results show support for the hypothesis that the effects of microgravity can be studied indirectly on Earth by measuring performance in an altered gravitational field. The hypothesis was that an altered gravitational field could disrupt performance on previously automated behaviors if gravity was a critical part of the stimulus complex controlling those behaviors. In addition, it was proposed that performance on secondary cognitive tasks would also degrade, especially if the subject was provided feedback about degradation on the previously automated task. In the initial experimental test of these hypotheses, there was little statistical support. However, when subjects were categorized as high or low in automated behavior, results for the former group supported the hypotheses. The predicted interaction between body orientation and level of workload in their joint effect on performance in the secondary cognitive task was significant for the group high in automatized behavior and receiving feedback, but no such interventions were found for the group high in automatized behavior but not receiving feedback, or the group low in automatized behavior. Author

N92-21549*# Center for NeuroDiagnostic Study, Inc., San Jose, CA.
ELECTROENCEPHALOGRAPHIC MONITORING OF COMPLEX MENTAL TASKS Final Report
RAUL GUISADO, RICHARD MONTGOMERY, LESLIE MONTGOMERY, and CHRIS HICKEY Washington Langley Research Center Feb. 1992 284 p
(Contract NAS1-18847)
(NASA-CR-4425; NAS 1.26:4425) Avail: NTIS HC/MF A13 CSCL 05/8

Outlined here is the development of neurophysiological procedures to monitor operators during the performance of cognitive tasks. Our approach included the use of electroencepalographic (EEG) and rheoencephalographic (REG) techniques to determine changes in cortical function associated with cognition in the operator's state. A two channel tetrapolar REG, a single channel forearm impedance plethysmograph, a Lead I electrocardiogram (ECG) and a 21 channel EEG were used to measure subject responses to various visual-motor cognitive tasks. Testing, analytical, and display procedures for EEG and REG monitoring were developed that extend the state of the art and provide a valuable tool for the study of cerebral circulatory and neural activity during cognition. Author

N92-21554# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: SCIENTIFIC AND TECHNICAL TERMS
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613573; INIS-MF-13049) Avail: NTIS HC/MF A01

This fact sheet explains the scientific and technical terms used in describing food irradiation processes. DOE

N92-21555# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: FOOD IRRADIATION AND RADIOACTIVITY
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Agency, Vienna, Austria
(DE92-613574; INIS-MF-13050) Avail: NTIS HC/MF A01
This fact sheet addresses the issue of whether food irradiation makes food radioactive and explains the difference between 'irradiation food' and 'radioactive food'. DOE

N92-21556# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: CHEMICAL CHANGES IN IRRADIATED FOODS
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613575; INIS-MF-13051) Avail: NTIS HC/MF A01
This fact sheet addresses the safety of irradiated food. The irradiation process produces very little chemical change in food, and laboratory experiments have shown no harmful effects in animals fed with irradiated milk powder. DOE

N92-21557# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: NUTRITIONAL QUALITY OF IRRADIATED FOODS
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613576; INIS-MF-13052) Avail: NTIS HC/MF A01
This fact sheet briefly considers the nutritional value of irradiated foods. Micronutrients, especially vitamins, are sensitive to any food processing method, but irradiation does not cause any special nutritional problems in food. DOE

N92-21558# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: GENETIC STUDIES
May 1991 4 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613577; INIS-MF-13053) Avail: NTIS HC/MF A01
Results published in the mid-1970s from the National Institute of Nutrition (NIN) in India showed increased numbers of polyploid cells in rats, mice, monkeys and malnourished children fed irradiated wheat products. This fact sheet considers the validity of these results. A large number of independent studies have been subsequently performed, and in none of these have results been obtained that support the NIN findings. The conclusion is that there is no evidence to link the consumption of irradiated food with any mutagenic effect. DOE

N92-21559# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: MICROBIOLOGICAL SAFETY OF IRRADIATED FOOD
May 1991 4 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613578; INIS-MF-13054) Avail: NTIS HC/MF A01
This fact sheet considers the microbiological safety of irradiated food, with especial reference to Clostridium botulinum. Irradiated food, as food treated by any 'sub-sterilizing' process, must be handled, packaged and stored following good manufacturing practices to prevent growth and toxin production of C. botulinum. Food irradiation does not lead to increased microbiological hazards, nor can it be used to save already spoiled foods. DOE

N92-21560# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: IRRADIATION AND FOOD SAFETY
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613579; INIS-MF-13055) Avail: NTIS HC/MF A01
This fact sheet focusses on the question of whether irradiation can be used to make spoiled food good. No food processing procedures can substitute for good hygienic practices, and good manufacturing practices must be followed in the preparation of food whether or not the food is intended for further processing by irradiation or any other means. DOE

N92-21561# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: IRRADIATION AND FOOD ADDITIVES AND RESIDUES
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613580; INIS-MF-13056) Avail: NTIS HC/MF A01
This fact sheet considers the issue of the irradiation of food containing food additives or pesticide residues. The conclusion is that there is no health hazard posed by radiolytic products of pesticides or food additives. DOE

N92-21562# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: PACKAGING OF IRRADIATED FOODS
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613581; INIS-MF-13057) Avail: NTIS HC/MF A01
This fact sheet considers the effects on packaging materials of food irradiation. Extensive research has shown that almost all commonly used food packaging materials toted are suitable for use. Furthermore, many packaging materials are themselves routinely sterilized by irradiation before being used. DOE

N92-21563# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: FOOD IRRADIATION COSTS
May 1991 2 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613582; INIS-MF-13060) Avail: NTIS HC/MF A01
This fact sheet gives the cost of a typical food irradiation facility (US $1 to $3 million) and of the food irradiation process (US $10 to 15 per ton for low dose applications; US $100 to 250 per ton for high dose applications). These treatments also bring consumer benefits in terms of availability, storage life and improved hygiene. DOE

N92-21564# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: IRRADIATED FOODS AND THE CONSUMER
May 1991 4 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613583; INIS-MF-13061) Avail: NTIS HC/MF A01
This fact sheet discusses market testing of irradiate food, consumer response to irradiated products has always been positive, and in some countries commercial quantities of some irradiated food items have been sold on a regular basis. Consumers have shown no reluctance to buy irradiated food products. DOE

N92-21589* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LUNAR RADIATOR SHADE Patent
MICHAEL K. EWERT, inventor (to NASA) 11 Feb. 1992 5 p Filed 25 Sep. 1991 Supersedes N92-11639 (30 - 2, p 292)
(NASA-CASE-MSC-21868-1; US-PATENT-5,086,828; US-PATENT-APPL-SN-765273; US-PATENT-CLASS-165-1; US-PATENT-CLASS-165-41; US-PATENT-CLASS-165-86; US-PATENT-CLASS-165-904; US-PATENT-CLASS-165-48.2; US-PATENT-CLASS-136-245; US-PATENT-CLASS-136-246)
Avail: US Patent and Trademark Office CSCL 06/11

An apparatus for rejecting waste heat from a system located on or near the lunar equator is presented. The system utilizes a reflective catenary shaped trough deployed about a vertical radiator to shade the radiator from heat emitted by the hot lunar surface. The catenary shaped trough is constructed from a film material and is aligned relative to the sun so that incoming solar energy is focused to a line just above the vertical radiator and can thereby isolate the radiator from the effects of direct sunlight. The film is in a collapsed position between side by side support rods, all of which are in a transport case. To deploy the film and support rods, a set of parallel tracks running perpendicular to length of the support rods are extended out from the transport case. After the support tracks are deployed, the support rods are positioned equidistant from each other along the length of the support tracks so that the flexible film shade between adjacent support rods is unfolded and hangs in a catenary shaped trough. A heat radiator is supported between each pair of support rods above each hanging reflective trough.
Official Gazette of the U.S. Patent and Trademark Office

N92-21590# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: SAFETY OF IRRADIATION FACILITIES
May 1991 4 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-613601; INIS-MF-13058) Avail: NTIS HC/MF A01

This fact sheet considers the safety of industrial irradiation facilities. Although there have been accidents, none of them has endangered public health or environmental safety, and the radiation processing industry is considered to have a very good safety record. Gamma irradiators do not produce radioactive waste, and the radiation sources at the facilities cannot explode nor in any other way release radioactivity into the environment. DOE

N92-21591# Food and Agriculture Organization of the United Nations, Rome (Italy).
FACTS ABOUT FOOD IRRADIATION: CONTROLLING THE PROCESS
May 1991 4 p Prepared in cooperation with World Health Organization, Geneva, Switzerland; and International Atomic Energy Agency, Vienna, Austria
(DE92-614091; INIS-MF-13059) Avail: NTIS HC/MF A01

This fact sheet briefly reviews the procedures that exist to control the process of food irradiation. It also summarizes the difficulties in identifying irradiated food, which stem from the fact that irradiation does not physically change the food or cause significant chemical changes in foods. DOE

N92-21972# Naval Weapons Center, China Lake, CA.
FIXED WING NIGHT CARRIER AEROMEDICAL CONSIDERATIONS
J. C. ANTONIO *In* AGARD, Aircraft Ship Operations 3 p Nov. 1991
Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Discussed here are the emerging use of night vision devices (NVDs) in the United States Navy/United States Marine Corps fixed wing aircraft, a description of the NVD environment, and the identification of aeromedical concerns associated with night carrier operations. Enhancements to the F-18 night strike mission provided by NVDs include increased situational awareness, enhanced night navigation, threat avoidance, multi/mixed aircraft tactics, nighttime use of daytime tactics, and the significant expansion of night air-to-air tactics, including escort missions. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

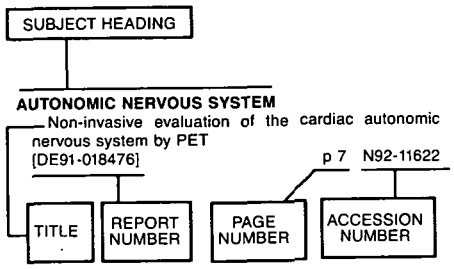
A92-30324
METHANE-PRODUCING MICROORGANISMS AS A COMPONENT OF THE MARTIAN BIOSPHERE [METANOBRAZUIUSHCHIE MIKROORGANIZMY - KOMPONENT BIOSFERY MARSA]
M. V. IVANOV and A. IU. LEIN (AN SSSR, Institut Mikrobiologii, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 321, no. 6, 1991, p. 1272-1276. In Russian. refs
Copyright

It is suggested that features of the isotope composition of carbonate carbon and the organic material of SNC meteorites on Mars can be explained by assuming that they have been formed as a result of the activity of autotrophic methane-producing bacteria. According to this hypothesis, the formation of the complex of sulfate and heavier-isotope carbonate minerals in association with light-isotope organic material took place in the presence of a secondary change in certain types of basalt-containing rocks on Mars under conditions of their near-surface change on the mother planet in unloading sites of solutions containing hydrogen, with the active participation of methane-producing bacteria. L.M.

N92-20353*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SPACE STATION CENTRIFUGE: A REQUIREMENT FOR LIFE SCIENCE RESEARCH
ARTHUR H. SMITH (California Univ., Davis.), CHARLES A. FULLER, CATHERINE C. JOHNSON, and CHARLES M. WINGET Feb. 1992 27 p Conference held in Davis, CA, Jan. 1986
(NASA-TM-102873; A-90309; NAS 1.15:102873) Avail: NTIS HC/MF A03 CSCL 06A

A centrifuge with the largest diameter that can be accommodated on Space Station Freedom is required to conduct life science research in the microgravity environment of space. (This was one of the findings of a group of life scientists convened at the University of California, Davis, by Ames Research Center.) The centrifuge will be used as a research tool to understand how gravity affects biological processes; to provide an on-orbit one-g control; and to assess the efficacy of using artificial gravity to counteract the deleterious biological effect of space flight. The rationale for the recommendation and examples of using ground-based centrifugation for animal and plant acceleration studies are presented. Included are four appendixes and an extensive bibliography of hypergravity studies. Author

Typical Subject Index Listing



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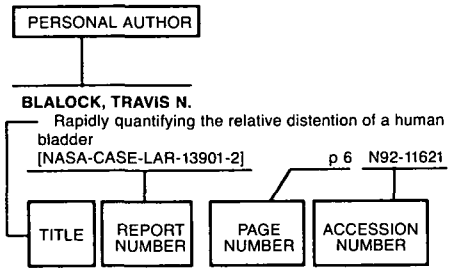

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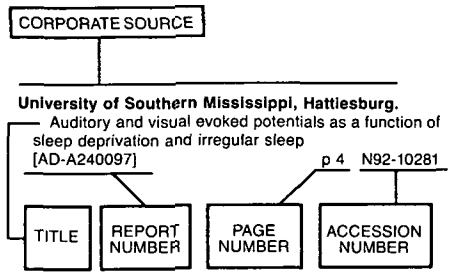

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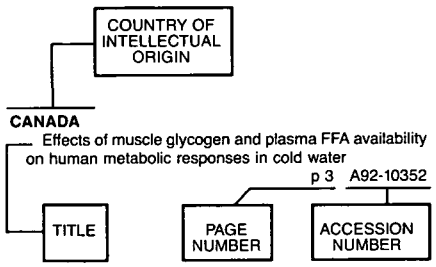

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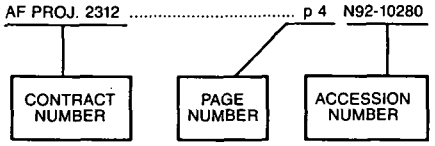

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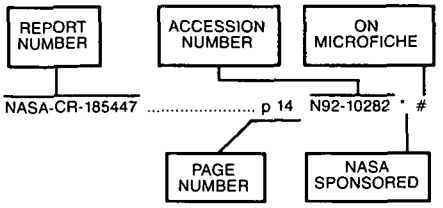

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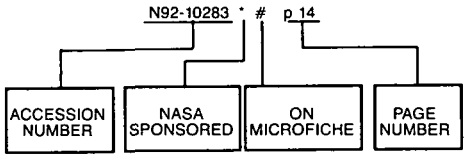

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