
INTRODUCTION. An AOI provides an auditory display of primary flight parameters. Evidence allowing the pilot to maintain spatial orientation while in a visual deprivation situation. This study assessed the pilot's performance using a flight simulator-tested AOI, which displays airspeed and vertical velocity as primary acoustic parameter on black and white visual display in the resultant gravity force vector created by a sustained linear acceleration in a typical laboratory. METHODS. Subjects were exposed to seven different visual scenes depicting acceleration over a shoreline through a wide field-of-view (34 x 34 deg) head-mounted display. The scenes contained horizontal, perspective, color, and motion cues in both isolation and various combinations. The capability to elicit vection may be sufficient for overcoming the SGI.

RESULTS. The AOI significantly reduced the amount of linear vector produced by the scenes. None of the participants reported any discomfort or fatigue. Although vertical velocity control tended to be better in the blind + AOI than in the blind-only condition, statistical significance was reached only in straight and level flight. CONCLUSIONS. The AOI enables a pilot to maintain blindfolded orientation in the absence of visual information. Its potential benefit on visual orientation control is evident, but the vertical velocity display needs to be improved.

DYNAMICS OF THE G-EXCESS ILLUSION. A. Baylor*1, M. Reschke*2, F. E. Gillingham*3, B. B. McGrath*4 and A. H. Respet*5. 1. Naval Aerospace Medical Research Laboratory, Pensacola, FL 32508-5706. 2. NASA, Johnson Space Center, Houston, TX 77058. 3. University of Pennsylvania. 4. Naval Medical Research Institute. 5. Naval Aerospace Medical Research Laboratory, Brooks AFB, TX 78235-5000.

INTRODUCTION. The G-excess illusion is recognized as a cause of aviation mishaps especially when pilots perform high-speed, steeply banked turns at low altitudes. Centrifuge studies of this phenomenon have examined the perception of subject orientation and target displacement during maintained hypergravity with the subject's head held stationary. The transient illusory perceptions produced by moving the head in hypergravity are difficult to describe, but the prolonged illusory orientation and target displacement during maintained hypergravity with the subject's head held stationary are responsible for the increasing reliance on visual information in the presence of the illusion. METHODS. Fourteen subjects flew on the NASA KC-135 were evaluated for the presence of strong nystagmus. Head movements (straight and level, 30° banked turn, deep turn, level-off from a gimballed maneuver) under four conditions (instrument hood, hood + AOI, blind, and blind + AOI). RESULTS. In all maneuvers the blind + AOI condition resulted in significantly better (p<0.05) bank angle control than the blind-only condition, and bank angle control in the blind + AOI condition was not significantly different from that obtained under either hood condition. CONCLUSIONS. The AOI can be used to maintain blindfolded orientation in the absence of visual information. Its potential benefit on visual orientation control is evident, but the vertical velocity display needs to be improved.
DELIVERY OF CARDIOPULMONARY RESUSCITATION IN THE MICROGRAVITY ENVIRONMENT. M. R. Barratt* and R. D. Billica*. KRUG Life Sciences and Medical Operations, NASA Johnson Space Center, Houston, TX.

INTRODUCTION. The microgravity environment presents several challenges for delivering effective cardiopulmonary resuscitation (CPR). Chest compressions must be driven by muscular force rather than by the weight of the rescuer's upper torso. Airway stabilization is influenced by the neutral body posture. Rescuers will consist of crewmembers of varying sizes and degrees of physical deconditioning from space-flight. Several ACLS protocols of CPR designed to accommodate these factors were tested in the one g environment, during parabolic flight, and on a recent shuttle flight. METHODS. Utilizing study participants of varying sizes, different techniques of CPR delivery were evaluated using a recording CPR manikin to assess adequacy of compressive force and frequency. Under conditions of parabolic flight, methods tested included conventional positioning of rescuer and victim, free-floating "aircraft." The hardware planned for use during the MTC phase of the space station was utilized to increase the fidelity of the space environment. Other constraints to delivery of ACLS onboard the space station included crew size, minimal training, crew deconditioning, and limited supplies and equipment. RESULTS. The delivery of ACLS in microgravity is hindered by the environment, but should be adequate. Factors specific to microgravity were identified for inclusion in the protocol including immediate restraint of the patient, and early intubation for airway management. Patients of varying sizes were studied to determine suitable CPR equipment. The delivery of effective CPR was dependent on precise restraint of the rescuer and patient, and rescuer size and preference. Free-floating CPR may be employed as a stop-gap method until patient restraint is available. Development of an adequate CCAD would be desirable to compensate for the effects of deconditioning.


The CMRS is a prototype system designed and developed for use as a universally deployable medical restraint/workstation on Space Station Freedom (SSP). The Shuttle Transportation System (STS), and the Assured Crew Rescue Vehicle (ACRV) for support of an ill or injured crewmember requiring stabilization and transportation to earth. The CMRS will support all medical capabilities of the Health Maintenance Facility (HMF) by providing a restraint/interfacet system for all equipment (Advanced Life Support packs, defibrillator, ventilator, portable oxygen supply, IV pump, transport monitor, transport aspirator, and intravenous fluids delivery systems), and personnel (patient and crew medical officers). It must be functional within the STS, ACRV, and all SSF habitable volumes. The CMRS will allow for medical capabilities within CPR, ACLS, and ATLS standards of care. This must all be accomplished for a worst case transport time scenario of 24 hours from SSF to a definitive medical care facility on earth.

A presentation of the above design prototype with its subsequent one year service experience in space continues to grow so will the ability to provide advanced health care planning and provisions for the Space Station. As a result of Congressional mandate Space Station Freedom (SSF) was restructured. This restructuring activity has affected the capabilities for providing medical care on board the station. This presentation addresses the health care facility to be built and used on the orbiting space station. This unit is named the Health Maintenance Facility (HMF), is based on and modeled after remote, terrestrial medical facilities. It will provide a phased approach to health care for the crew of SSF. Beginning with a stabilization and transport phase, HMF will expand to provide the most advanced state of the art therapeutic and diagnostic capabilities. This presentation details the capabilities of such a phased HMF. As Freedom takes form over the next decade there will be ever-increasing engineering and scientific developmental activities. The HMF will evolve with this process until it eventually reaches a mature, complete, stand-alone health care system. The detailed presentation will focus on those design aspects of the HMF which will be most influential in the development of the space station and beyond.

A PROTOTYPE CREW MEDICAL RESTRAINT SYSTEM (CMRS) FOR SPACE STATION FREEDOM. S. L. Johnson*, R. D. Billica*. KRUG Life Sciences and Medical Operations, NASA Johnson Space Center, Houston, Texas.

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ADVANCED CARDIAC LIFE SUPPORT (ACLS) UTILIZING MAN-TENDED CAPABILITY (MTC) HARDWARE ONBOARD SPACE STATION FREEDOM. M. Smith, M. Barratt, C. Lloyd. NASA and KRUG Life Sciences, Inc. Medical Operations Branch, Johnson Space Center, Houston, Texas. 77058.

INTRODUCTION. Because the time and distance involved returning a patient from space to a definitive medical care facility, the capability for Advanced Cardiac Life Support (ACLS) onboard the Space Station Freedom is of utmost importance. In order to evaluate the effectiveness of terrestrial ACLS protocols in the microgravity environment, a medical team conducted simulations during parabolic flight onboard the KC-135 aircraft. The hardware planned for use during the MTC phase of the space station was utilized to increase the fidelity of the space environment. Other constraints to delivery of ACLS onboard the space station included crew size, minimal training, crew deconditioning, and limited supplies and equipment. RESULTS. The delivery of ACLS in microgravity is hindered by the environment, but should be adequate. Factors specific to microgravity were identified for inclusion in the protocol including immediate restraint of the patient and early intubation for airway management. Patients of varying sizes were studied to determine suitable CPR equipment. The delivery of effective CPR was dependent on precise restraint of the rescuer and patient, and rescuer size and preference. Free-floating CPR may be employed as a stop-gap method until patient restraint is available. Development of an adequate CCAD would be desirable to compensate for the effects of deconditioning.