3 NEUROLOGY → 3. characterization of SMS — Garn — DO NOT type

6. Kinesthetic Repeatability and Eye-hand Tracking (EHT)

27 Oct, '85

~~Kinesthetic Repeatability &~~ ~~Eye Hand~~

Background: I

In weightlessness, major loads are removed from ~~both~~ muscles and from a variety of proprioceptive sensors, especially force sensors. ~~Since this is a never~~ ~~While~~ In conditions of gravity these sensors, frequently adapt rapidly, ~~are frequently rapidly adapting, it would be mostly and we are used to~~ doing working at all angles in relation to the gravity vector, and virtually all ~~control~~ actions are modulated if not initiated by the cerebellum and higher centers. In weightlessness signals from the gravity sensitive otolith organs are ~~m~~ distorted and incongruent; ~~with~~ semicircular canal, vision and other sensory inputs ~~and~~ can in some subjects ~~and~~ cause SMS.

~~Earlier studies by the author from STS-5 thru 07 showed the c~~ There are extensive vestibular inputs to the higher centers of the CNS, (and especially to) the cerebellum ~~& even~~ as well as to the spinal cord. Without study one could not be sure that weightlessness would not affect ~~muscular acts~~ ~~mo~~ movements, especially finely coordinated movements and especially during SMS when a major sensory conflict is present. ~~Simple~~ Observation operational experiences demonstrated that during muscular activities were not significantly affected by weightlessness and while it was difficult to say the same during SMS there were not glaring difficulties

CNS = central Nervous System

To document this in a more sensitive and orderly fashion, one of the simplest tests of ~~so motor active action~~ sensori-motor function, was devised ~~on~~ for use on STS-5 and continued on STS-7. ~~It~~ This test consisted of ~~pu~~ choosing ~~with~~ without looking a spot in space and adjacent to a ~~seco~~ chart and marking the chart ~~c a scr~~ at that point with a scribe, ~~and~~ moving the hand away in a given plane and then attempting to return ~~returning~~ to the same point in space and again marking the chart at the new point. This was repeated a number of times with and without loading equivalent to weight of the segment used. No significant errors were found ~~to be~~ in normal subjects in weightlessness.

This study was refined and expanded on STS-8 by making a recorder which moved a wide paper chart past a marker pen free to move transversely across the paper.

In addition to measuring kinesthetic sensitivity, a ~~second~~ visual tracking task was added by prerecording ~~a~~ sine and ~~sawtooth~~ triangular waves at various frequencies and amplitudes and a series of random step functions. This was used extensively on STS-8 but not during motion sickness.

~~In attempt to~~ To reduce size & weight and to facilitate automatic data analysis, an electronic recording scale

with
~~&~~ an LED tracking display was constructed to specification for ~~STS-8~~ shuttle flights. It had provision for both kinesthetic ~~&~~ testing ~~as well as~~ and eye hand tracking; it was flown ~~on~~ and used on Skylab-3 ~~SL-3~~, but not during the SMS period. ~~Fig~~ Results of earlier kinesthetic testing ~~was~~ were confirmed and ~~while and not was~~ were no anomalies there in significant changes in E.H.T. in normal crewmen.

~~Results~~ Procedures ~~&~~ and Operations:

The electronic tracking unit consists of a ~~track~~ cm linear track ~~to~~ ___ cm along which a pointer and handle is free to move. Adjacent to the track is a linear array of 50 LEDs one of which is illuminated. An internal generator ~~sequentially~~ drives the illuminated LED in a ~~sequ~~ sequence of functions Fig —. Position of pointer and light is recorded by the frequency modulation instrumentation recorder. In the ~~eye~~ kinesthetic position mode, the pointer position is recorded as the subject chooses a ~~position~~ spot with eyes averted, moves the pointer away from it, and attempts to repeat the original position for a total of ten times with ~~elbow~~ shoulder rotation only. This is then repeated with free use of all arm joints.

Eye hand tracking ~~is~~ consists consists of attempting to maintain the pointer ~~beside~~ on the lighted LED as it goes through ~~progresses~~ the various functions which are displayed for tracking.

Results/Analysis: The schedules is shown in ___ . Records were routinely obtained on preflight during training and on mission days ___ and ___ . Operational was nominal. Results were recorded on an electrostatic recorder were a span of ___ cm, and at speeds of ___ mm. sec. In addition, the eye hand data was processed by subtracting the command signal from the tracking signal, the absolute value of the resulting error signal obtained, and whole summated. Tracking delays, and over and undershoots were measured from the step functions.

The resulting analysis showed that the subject tracked the functions very well both on earth and in orbit. Kinesthetic repeatability was also normal.

Conclusions: The goal of comparison of performance during SMS and after recovery was defeated by absence of data. All hardware worked well.