Efforts are underway to incorporate a visual vection component into the task for a flight study.

MANUAL CREW OVERRIDE OF VEHICLE LANDINGS FOLLOWING G-TRANSITIONS

H. M. Weiss[1], A. M. Bollinger[1], K. R. Duda[2], D. H. Wheelock[3], and S. J. Wood[3]

[1] KBR, Houston, TX, [2] The Charles Stark Draper Laboratory, Inc., Cambridge, MA, [3] NASA Johnson Space Center, Houston, TX

Background

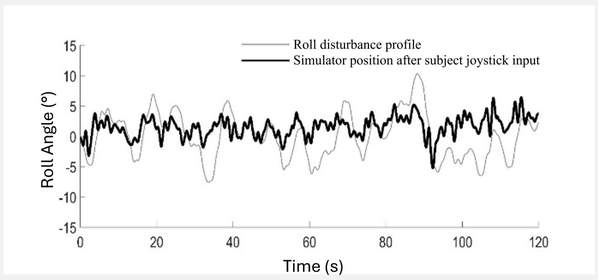
- Crew control of piloted spacecraft during exploration spaceflight consists of both planned automated supervisory control and unplanned manual override and control
- Physiologic changes that optimize sensorimotor function in microgravity can be maladaptive for transitions to other gravity states
- Crew override capability is critical to enable overall mission success during landing contingencies
- While training and landing aids can help overcome these adaptive changes, increases in cognitive demand need to be accounted for in a manual override piloting strategy

Objectives

1. *Characterize the impact of spaceflight on crew capability to perform manual crew override* of a simulated lunar landing vehicle
   a. Short duration Private Astronaut missions
   b. Long duration ISS missions
2. *Examine how measurements in vestibular and cognitive function relate to proficiency during supervisory manual control and crew override.*
3. *Compare performance during on-board just in time training late in-flight with landing tasks conducted early in the postflight period*
4. *Evaluate assessments of performance in healthy ground control subjects*
   a. Shadow control subjects (within ±5 years age range and the same sex as crew)
   b. Ground subjects to evaluate learning effects

Motion Perception Nulling Task

Participants will use a hand controller to maintain upright posture against pseudorandom roll-tilt disturbances on a motion platform, with or without static or moving visual components



Unplanned Manual Override and Control

- Crew will monitor the automatic flight trajectory before a commanded manual takeover
- Crew will manually control pitch/roll/yaw attitude and rate of descent to nominal or re-designated landing aimpoint
- Pilots are required to simultaneously monitor system displays and warnings requiring user input (dual tasking)

Dependent Measures

- Percent time outside of recommended vehicle state parameters
- Touchdown performance (e.g., range from target site, heading error, rate of descent, attitude.)
- Reaction time for secondary cognitive tasks
- Point of regard tracking (Tobii Pro)
- Motion Sickness
- Sleepiness
- Modified Bedford Scale

Planned Automated Supervisory Control

- Crew will monitor simulated window visual and navigational displays to determine when/if a re-designation is required using a tablet device
- Simultaneously monitors system displays and warnings requiring user input (dual tasking)

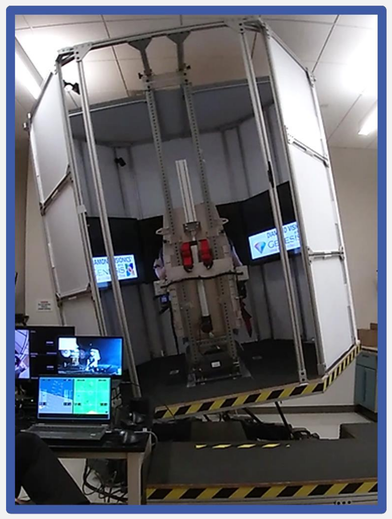
Dependent Measures

- Divert performance considering hazards, navigation bias, landing site safety
- Reaction time for dual tasks with varying difficulty
- Modified Bedford Scale

Acknowledgements

This work was authored by employees of The Charles Stark Draper Laboratory, Inc. under Contract No. 80JSC021DA005 with the National Aeronautics and Space Administration. The United States Government retains and the publisher, by accepting the article for publication, acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, worldwide license to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, or allow others to do so, for United States Government purposes. All other rights are reserved by the copyright owner. The authors also acknowledge the HLS Joint Test Panel, Crew HLS Interfaces for Piloting Working Group, and Dynamic Skills Trainer (DST) Lab. This project is funded by the Human Health Countermeasures Element.

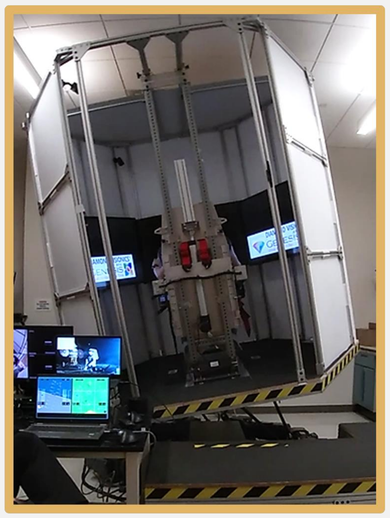
Lunar Landing Simulation on 6DOF Motion Base



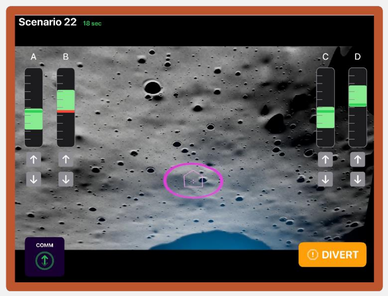
Portable Lunar Landing Simulation

Onboard Trainer

Motion Perception Nulling on Motion Base

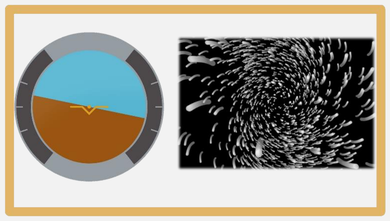


Flight Avionics Panel



Multi-Attribute Lunar Tablet

Translational and Rotational Hand Controllers



Roll Nulling with Visual Vection