



National Aeronautics and Space Administration
Johnson Space Center (JSC) / White Sands Test Facility (WSTF)

Test Bed for Human Performance in Mockup Suit

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Technology Area (TA): 6.2 Extravehicular Activity Systems; 6.3 Human Health and Performance TRL: start 2 / current 3

ICA PROJECT OVERVIEW

Crewmembers' ability to adjust to changes in gravity and sensorimotor function is essential for successful suited mobility in lunar and planetary missions. Setups for current pressurized spacesuit testing require suit technicians, specialized medical clearances, and test support personnel along with increased risk to the subject. Furthermore, suited setups constrain the types of additional hardware that can be used. A test bed was developed with the goal to evaluate human suited performance using an unpressurized Mark III mockup suit and virtual reality (VR) system.

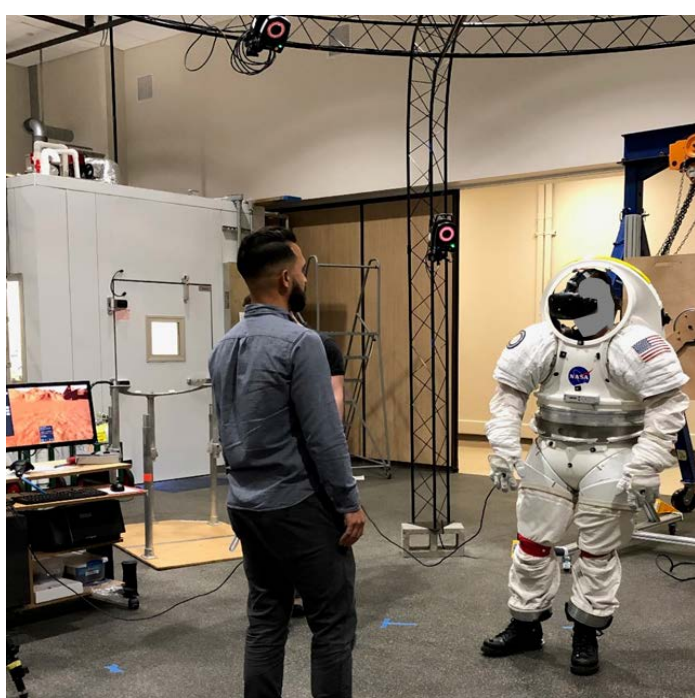
INNOVATION

The mockup suit provides a means of performing proof-of-concept tasks for suited performance with lower time and cost demands. Additionally, VR goggles provide a means for projecting an immersive planetary environment and applying perturbations to the visuo-vestibular system with minimal equipment. Furthermore, the test bed will be developed to allow room for improvement in fidelity for future suited applications.

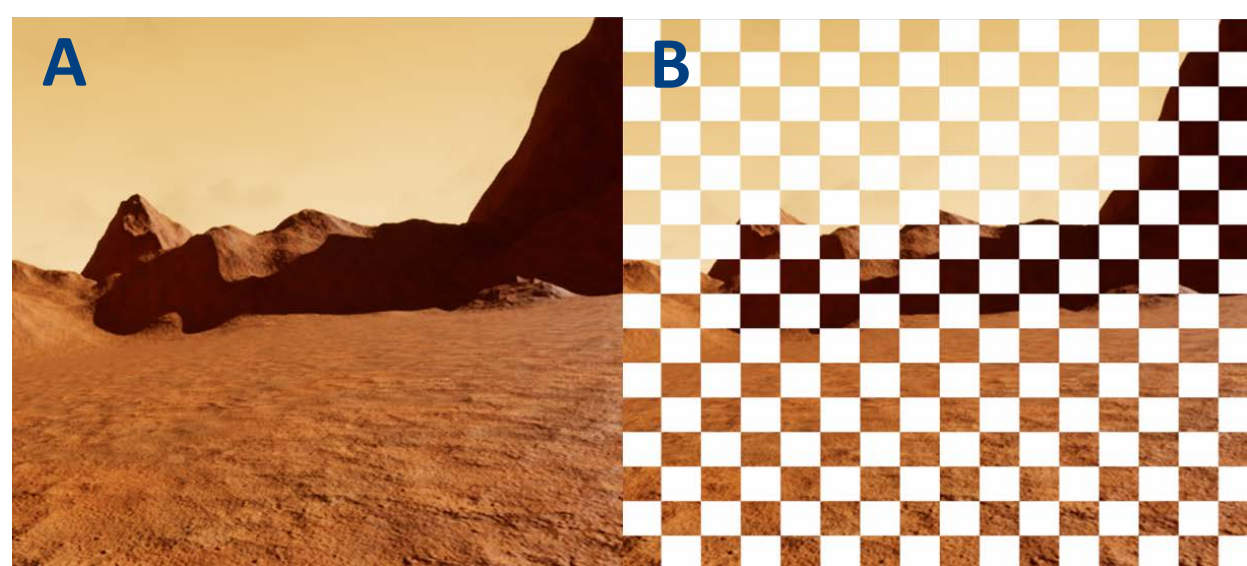


Mark III mockup suit and VR goggles

OUTCOME



Testing pre-check for fit, mobility, and VR immersion



(A) Virtual Mars-like environment; (B) Sample of virtual environment with visual perturbation

- Successful pilot testing of 3 subjects in mockup suit with VR and motion capture (3 posture tasks and 3 walking tasks)
- Received valuable feedback from subjects which will assist in further development of test bed protocol and improvements for VR environment
- Valuable feedback received from suit technicians for future improvements for mockup suit fit

INFUSION SPACE / EARTH

- VR goggles can be used as portable tool for training of visuo-vestibular deconditioning effects during lunar and planetary missions

- Test bed provides framework for quick performance manipulations for on-the-ground validation of lunar and planetary changes as well as their countermeasures

PARTNERSHIPS / COLLABORATIONS

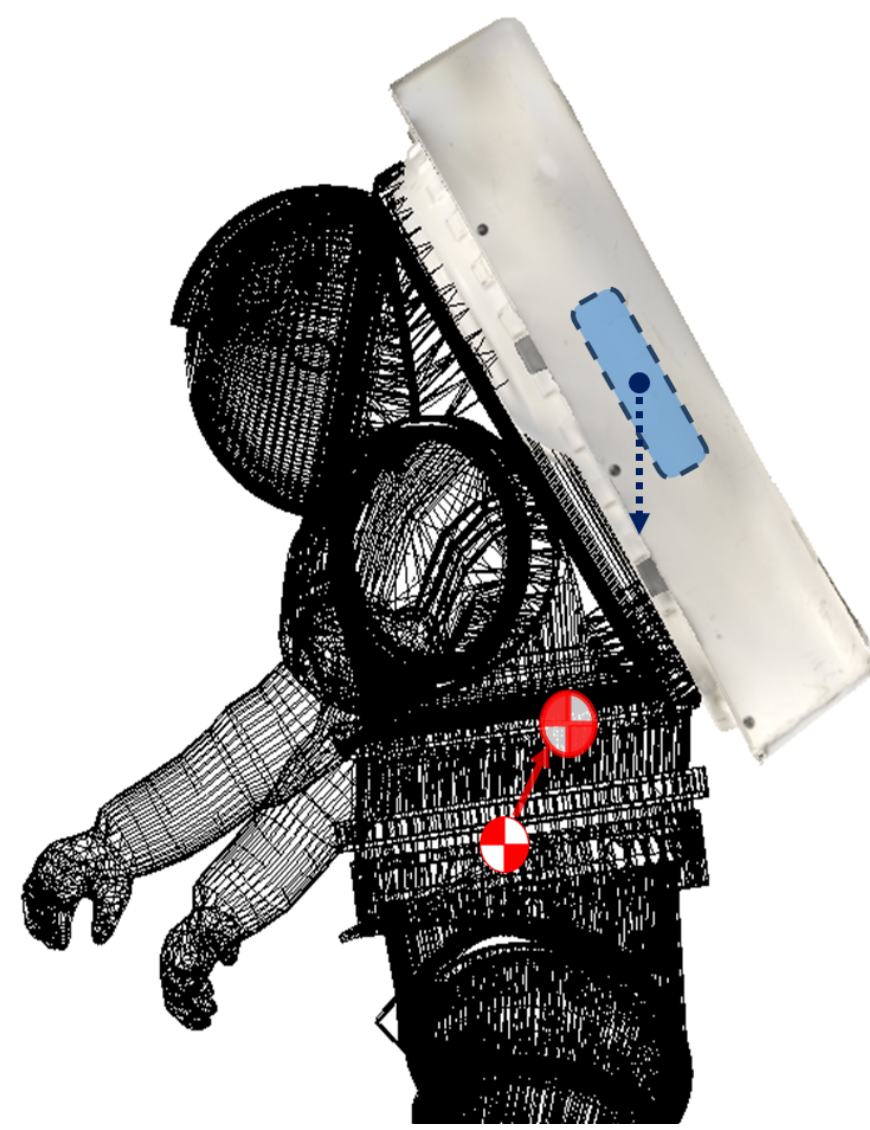


NASA JSC SK and EC5 continue their strong collaboration. Future development focus will be collaboratively identified with NASA suit engineering and other stakeholders.

PAPERS / PRESENTATIONS

Feedback and lessons learned from evaluating human performance in the mockup will be used internally and with NASA suit engineers for improving future mockup suit testing.

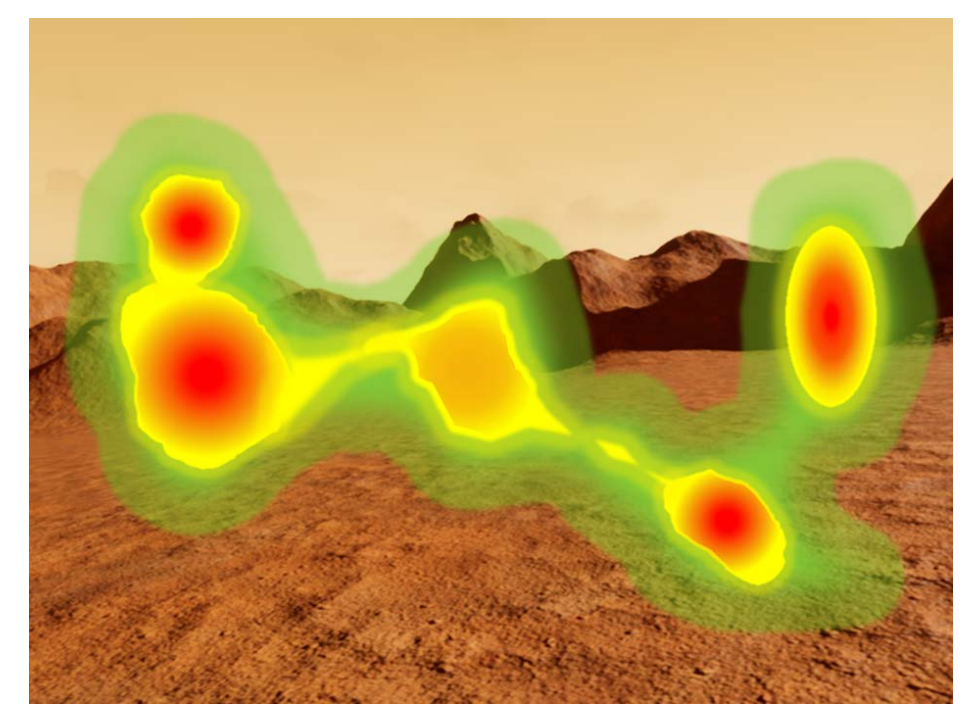
FUTURE WORK



Visual model for shifting the overall center of gravity (red target) by systematically adding weight (blue rectangle) to the PLSS unit



Embedded eye-tracking in VR goggles



Visual model for projection of eye gaze via "heat map" onto virtual scene

Continued test bed development efforts will focus on the VR system and mockup suit for added fidelity, including:

- Enhancement of the immersiveness of the VR environment via increase in virtual volume as well as improvement in subject special awareness and interactivity (i.e. visible foot markers)
- Increase of visual perturbation intensity
- Development of eye tracking for analysis of eye gaze and targeting
- Increase of suit performance manipulations via systematic weight modifications to the portable life support system (PLSS)
- Development of suit internal support system (i.e. straps) to better distribute weight