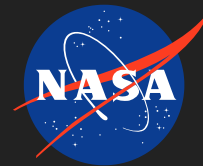


Test Bed for Human Performance in Mockup Suit

Completed Technology Project (2019 - 2019)



Project Introduction

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.

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.

Anticipated Benefits

The anticipated benefit of this novel proof-of-concept test bed is providing JSC a tool for other labs and groups to help evaluate suited motion from both a physical and cognitive aspect. This test bed will allow human performance testing in a suited environment without the need of pressurization or offloading. However, when time and resources allow, this test bed can also be applied to higher-fidelity testing so that results can be more predictive for lunar and planetary performance. The test bed will be designed to allow other labs and facilities to further develop performance testing by adding updated technology, sensors, and techniques.

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



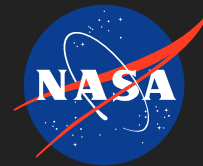
Pilot testing subject pre-check for fit, mobility, and VR immersion

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Closeout Summary	2
Organizational Responsibility	2
Project Management	2
Closeout Documentation	3
Images	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, TX

Primary U.S. Work Locations

Texas

Closeout Summary

The study team was able to successfully collect posture, walking and subject data as well as subject feedback on suit performance from 3 subjects while they donned the mockup suit. Despite lack of time for iterative improvements to the test bed protocol, the setup and scheduling process from 3 human-in-the-loop test sessions as well as the subject feedback provided lessons learned for future improvements. Such lessons included the level of suit technician support for testing, the weight distribution of the mockup suit on subjects, the potential for the PLSS unit to provide future center of gravity manipulations, and the improvements needed for the virtual environment and its visual perturbations. Such lessons can be immediately applied to future mockup suited testing. This proof-of-concept model, which needs further improvement prior to final testing and application, the study ended as a TRL 3.

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Independent Research & Development: JSC IRAD

Project Management

Program Manager:

Christopher Culbert

Project Manager:

Ronald G Clayton

Principal Investigator:

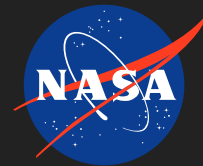
Eduardo J Beltran

Co-Investigators:

Marissa J Rosenberg
Sudhakar Rajulu
Sarah L Jarvis
Linh Q Vu

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Closeout Documentation

2019 Tech Showcase Poster - Test Bed for Mockup Suit

(<https://techport.nasa.gov/file/38101>)

Images



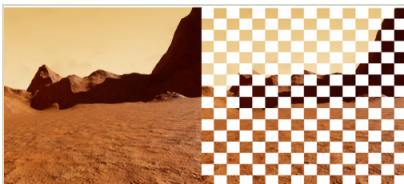
Mark III mockup suit and VR goggles

Image of mannequin wearing test assembly - Mark III mockup suit and VR goggles



Mockup Suit Test Pre-Check

Pilot testing subject pre-check for fit, mobility, and VR immersion

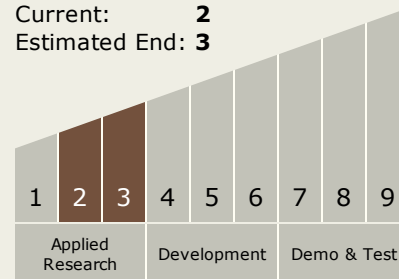


VR environment

VR environment projection of Mars-like environment with and without visual perturbation

Technology Maturity (TRL)

Start: 2
Current: 2
Estimated End: 3



Technology Areas

Primary:

- TA6 Human Health, Life Support, and Habitation Systems

Target Destinations

The Moon, Mars, Foundational Knowledge