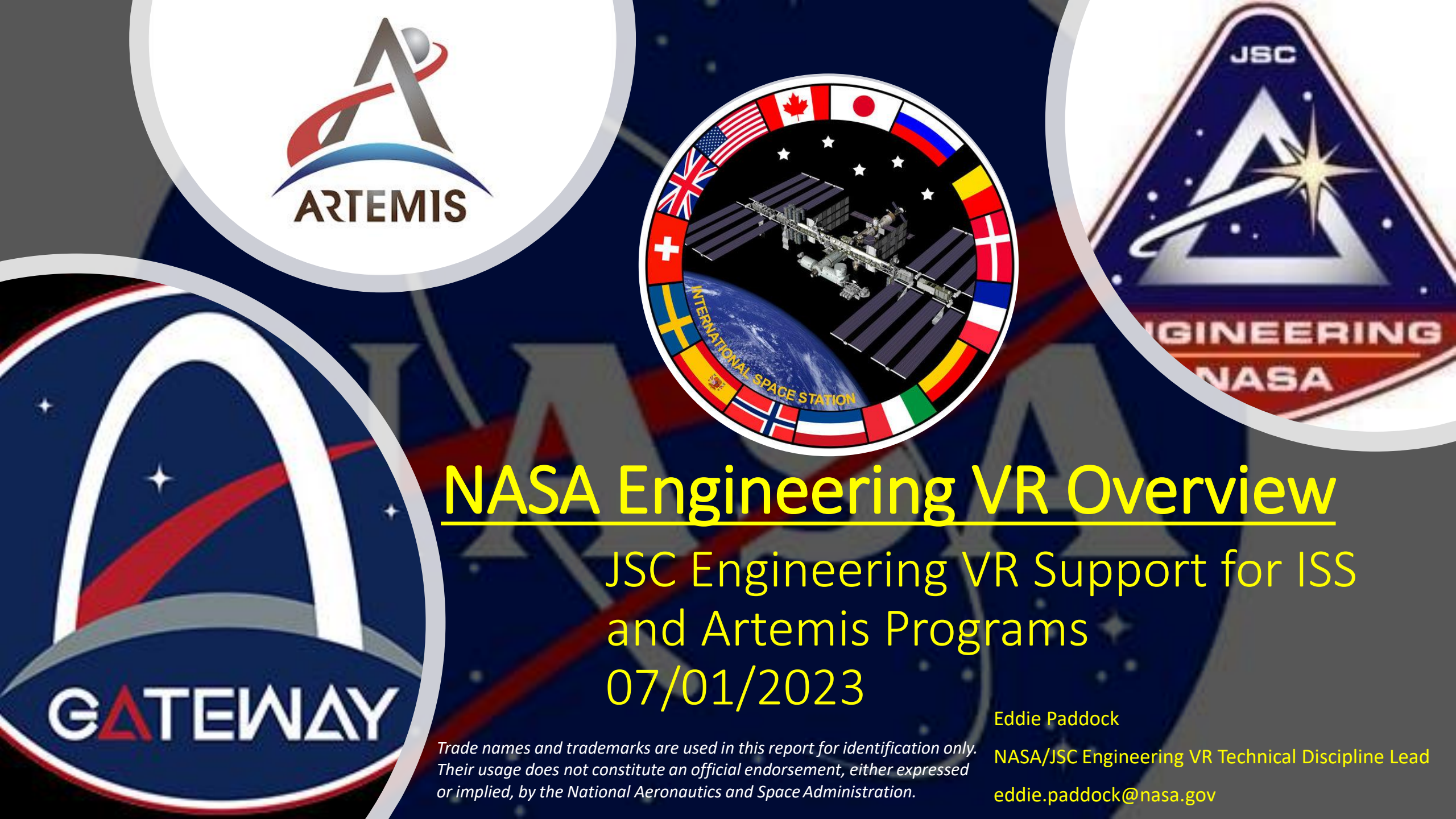

NASA Engineering VR Overview

JSC Engineering VR Support for ISS and Artemis Programs

07/01/2023

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JSC's Virtual Reality Lab (VRL)

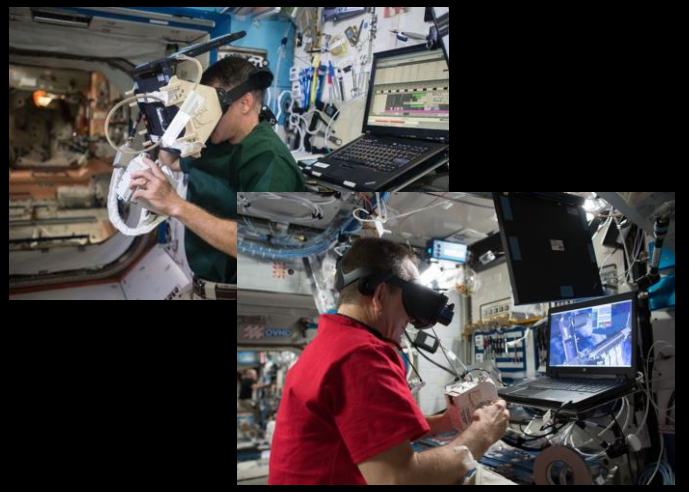
Dual EVA-1 and EVA-2 VR Training

ISS EVA, Robotics and SAFER VR Training

Mass Handling Robot

EVA DOUG Training Animations

Integrated ISS Robotics Systems - RWS

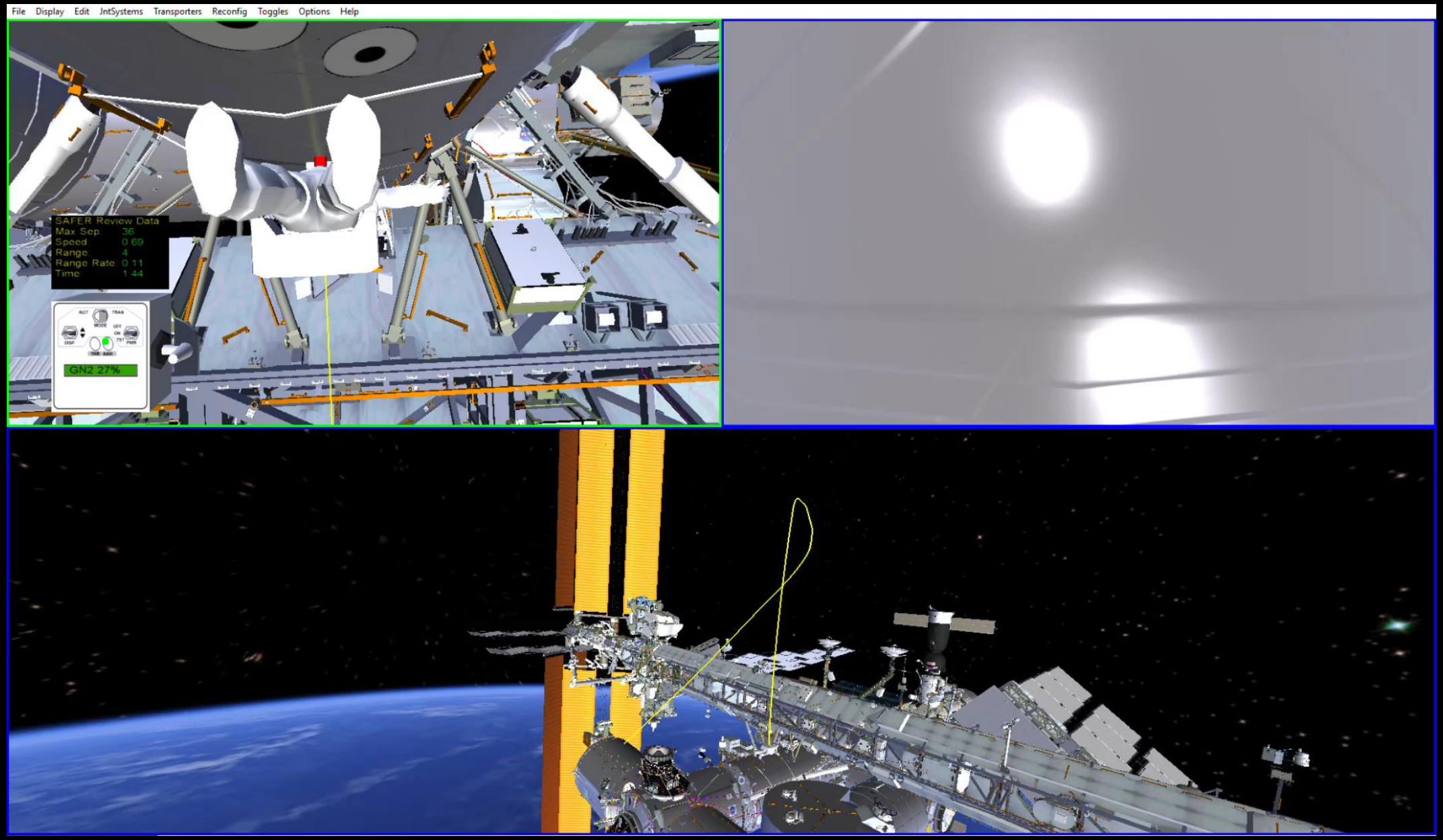


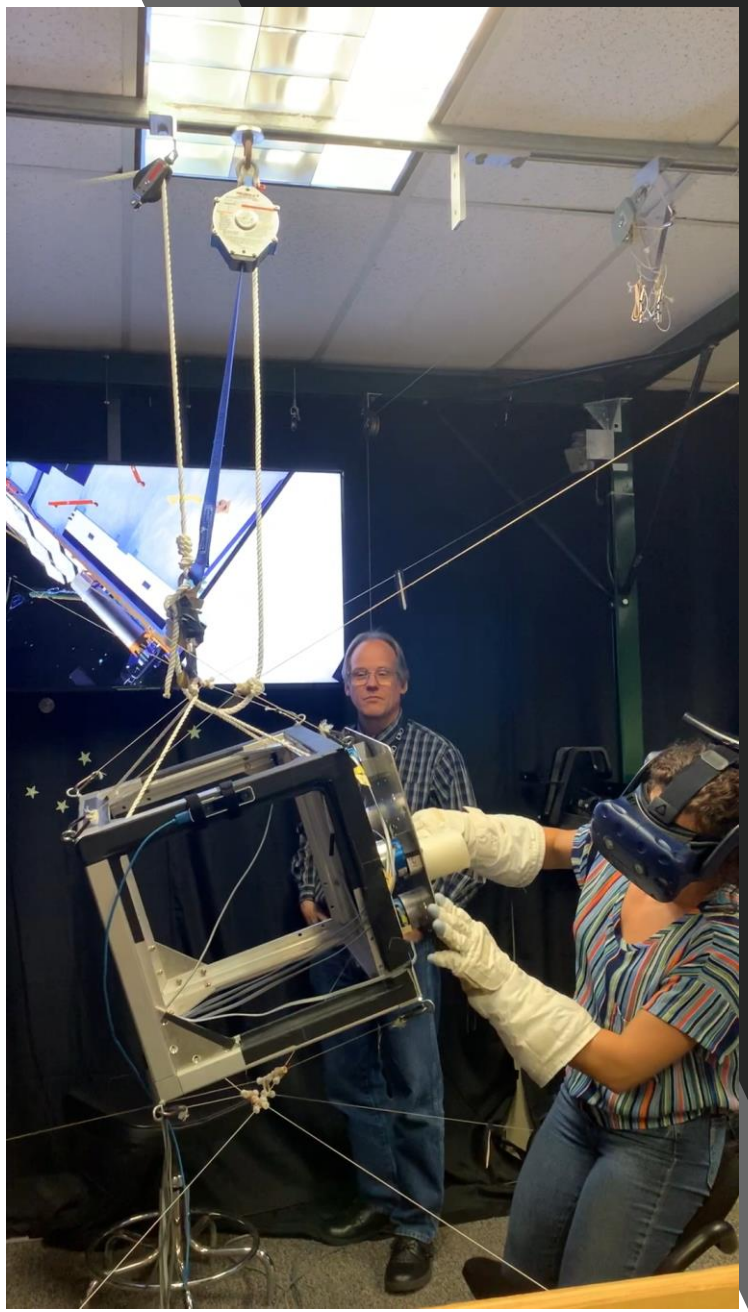
SAFER Onboard VR Training Laptop and Oculus Rift

SAFER VR-MR Training

- Vive Pro - wireless
- Tracking pucks for body and hands
- Custom gloves supporting hand closure gestures
- FEU hand controller, avionics and FSW,
- Real-time human-in-the-loop Trick based simulation
  - Orbital dynamics
  - Simulated propulsion, forces and torque dynamics
- DOUG VR Graphics
- Lower fidelity trainer is available onboard ISS SSC laptop with modified Oculus Rift – Virtual Reality Trainer (VRT)
- Working on upgrade to onboard VRT with stand alone Quest
  - Having problems finding workable micro-gravity compatible (tracking in zero-g) HMD

SAFER VR Training – Review Tool





Mass Handling VR-MR Training

- Vive Pro - wireless
- JR3 force/torque sensors
- Configurable payload hand holds
- Real-time (2,000 Hz) Trick based HDW-in-loop simulation
  - Simulated contact, forces and torque dynamics
- DOUG VR Graphics

- Mass Handling system is composed of two robots (EVA1 and EVA2) supporting dual integrated EVA operations on single payload
  - Mass handling training scenario can include integrated ISS Robotics with EVA astronaut on end of SSRMS
  - Recently upgraded motors, avionics, sensors and RT controller

11/21/2019 ISS Integrated EVA VR and ROBoT Training in Preparation for AMS Repair EVA

Robotic OnBoard Trainer (ROBoT)

JSC's Prototype Immersive Technologies (PIT) – XR R&D Lab

PIT Lab – Building 16, room 2115

OptiTrack with Integrated Oculus VR

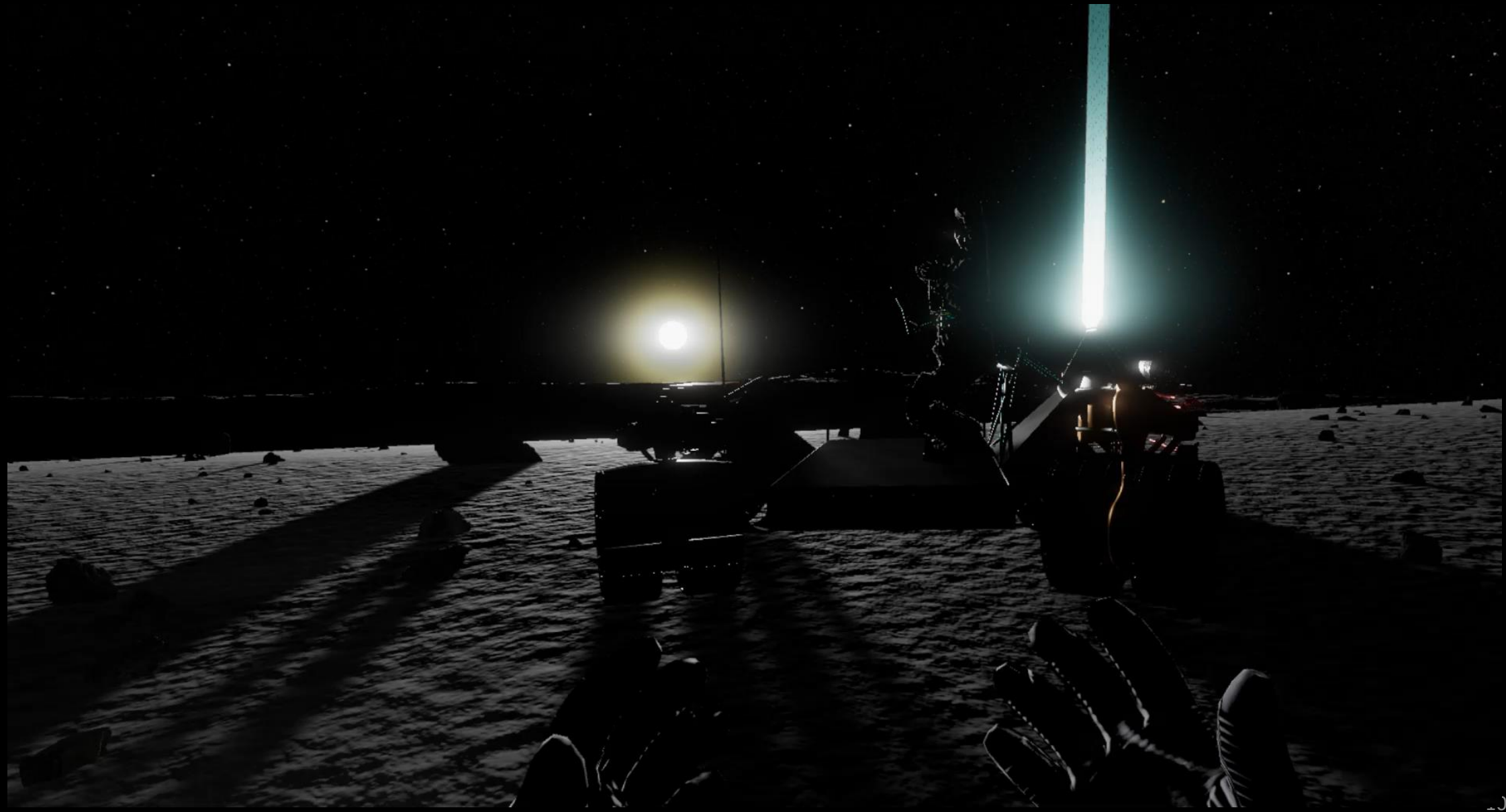
OptiTrack Motion Capture use with Digital Astronaut and Microgravity Exercise Device Analysis Projects

Overview of Lunar Surface Visualization Work

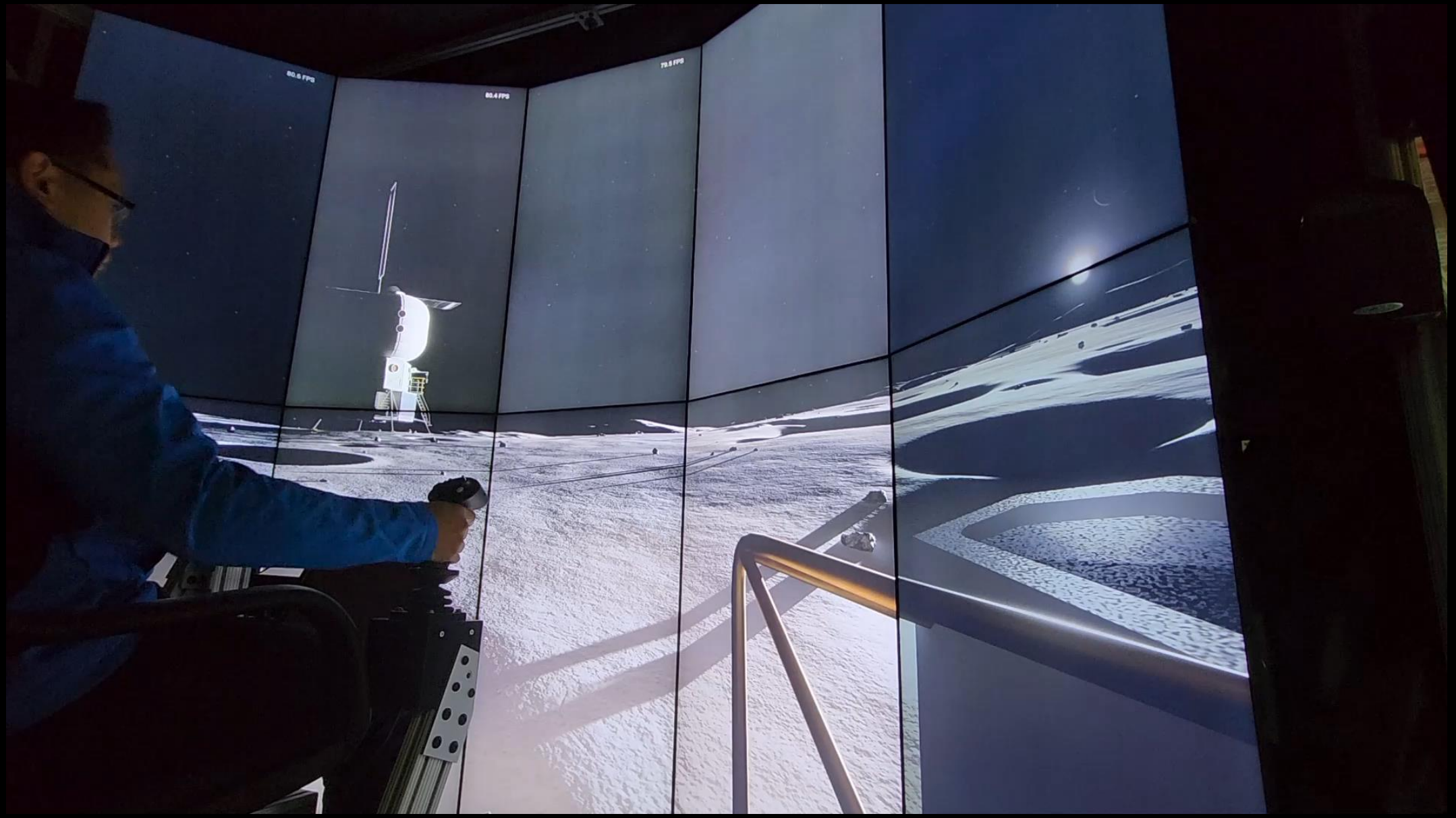
- Supporting Artemis, Gateway and xEVA Mission Visualization Requirements
  - VR and Desktop Tools for Early Analysis and Risk Reduction for Lunar Surface Operations
  - Future Training Applications
- Building up Lunar South Pole terrains from available Digital Elevation Map (DEM) data and science community statistical data for craters and rock distributions
- Incorporating xEMU suits, Rovers, tools, lander and rover 3D model designs
- Integrating ephemeris planetary data for date and location lighting effects
- Integrating available artificial lighting data for xEVA suit and LTV lights
- Working EVA and LTV Rover VR and Video Wall test scenarios for HITL Crew studies including way point traverses, rock inspections and tool use in different location and lighting conditions
- Working Lunar Surface EVA VR Navigation Crew Studies and Flight Controller Interfaces
- Integrating Lunar Surface VR applications into ARGOS for Lunar gravity lander egress/ingress analysis and future training
- Building up Mixed Reality Lander Trainer Prototype with Varjo HMD
- Moving to Unreal5.1 for Visuals
  - Developed real-time GDAL/Clipmap for terrain rendering directly from DEM data
  - nDisplay for Video Wall
  - DUST (DLES Unreal Simulation Tool) – Desktop Tool for Lunar Surface Analysis
  - Working moving to Unreal for VR

DUST

Unity Multi-Client Lunar Surface EVA VR Video

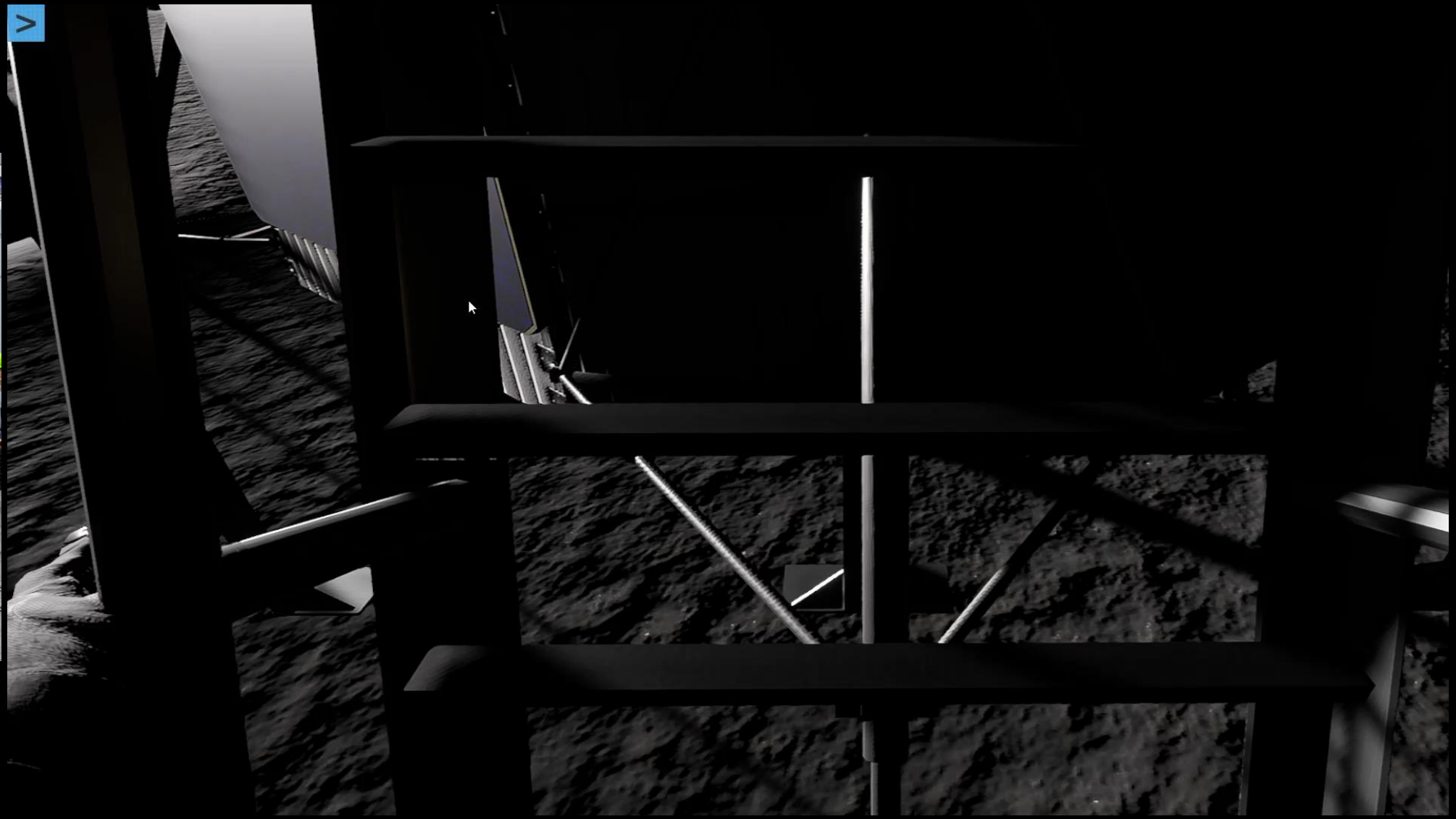


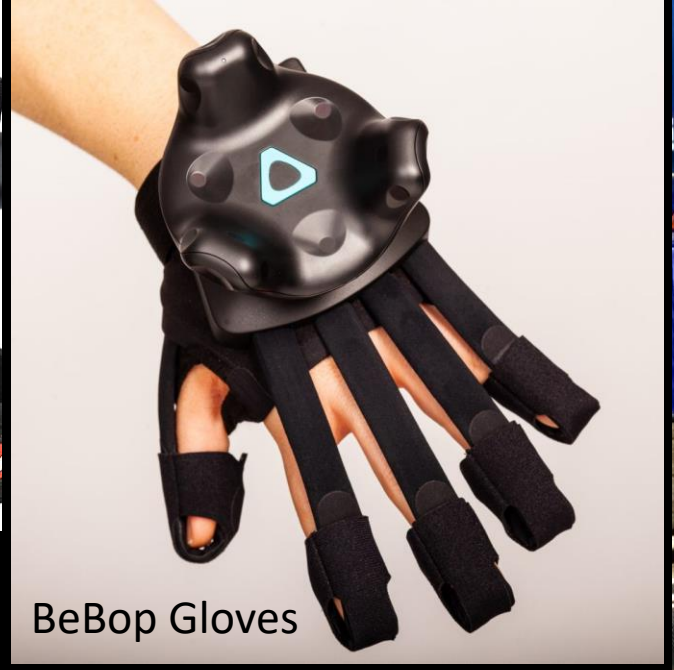
Rover Simulation at SES Video Wall

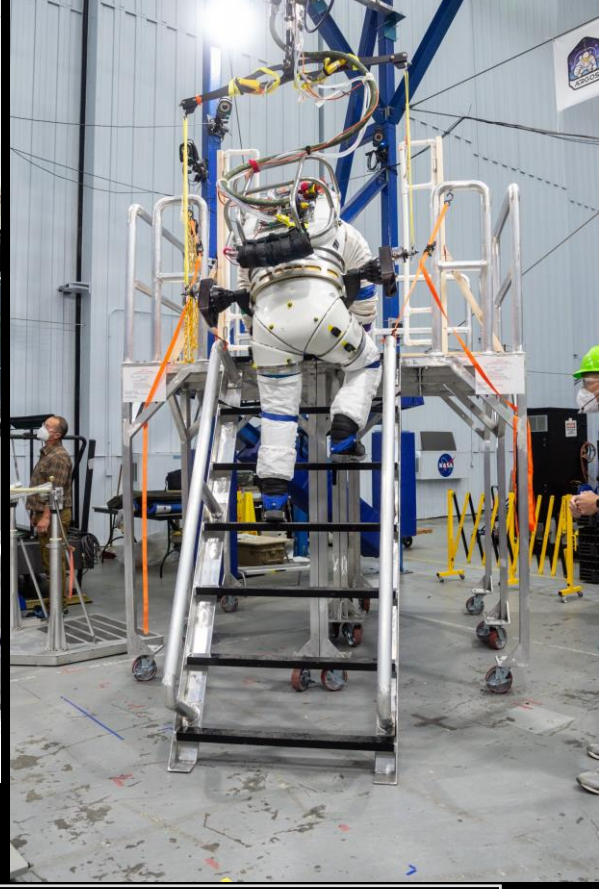


Rover Simulation at Motion Base/VR

VR/ARGOS (Active Response Gravity Offload System) Test Video





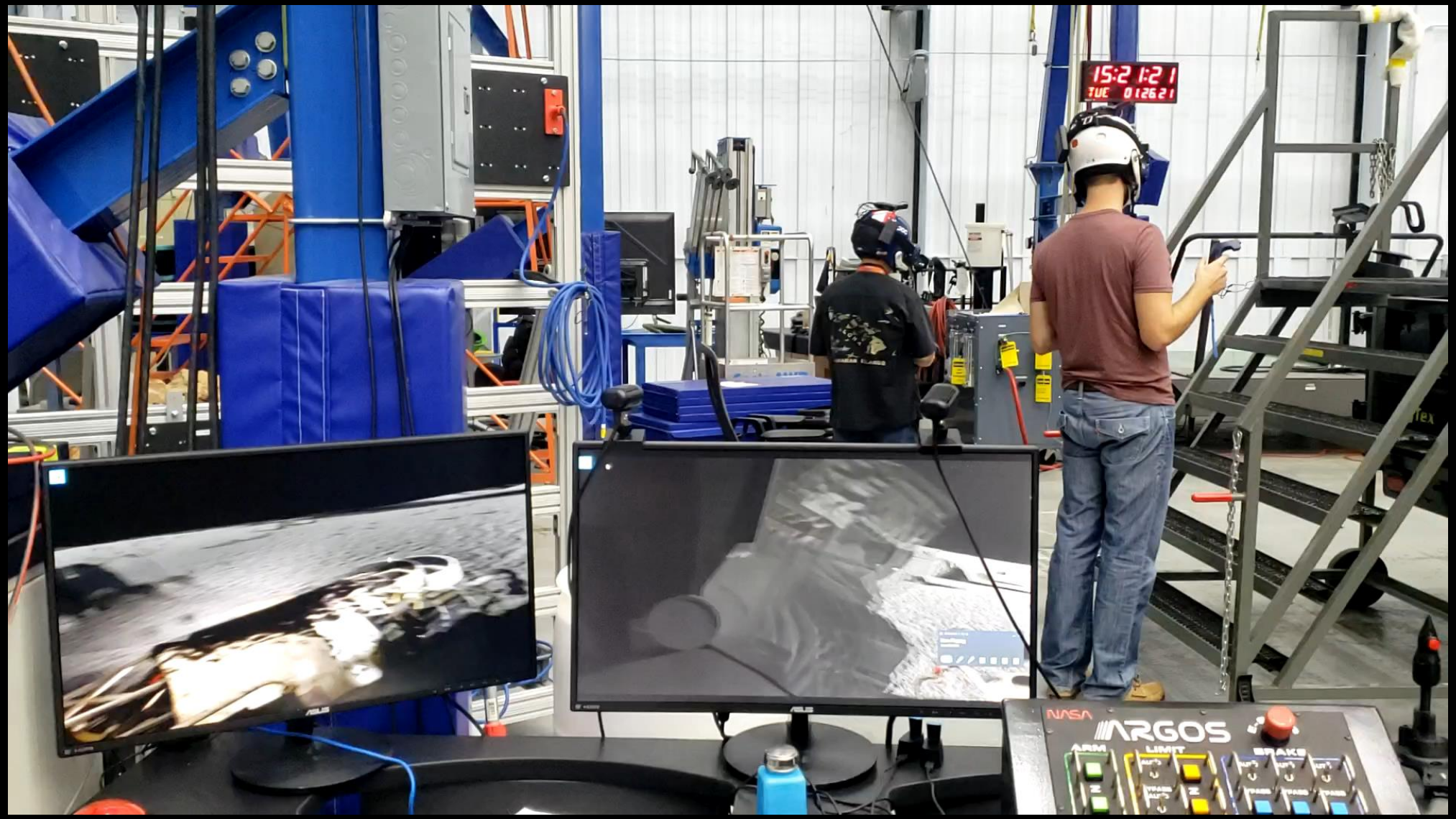


XR and ARGOS
CIF Lunar Lander Egress/Surface EVA Project

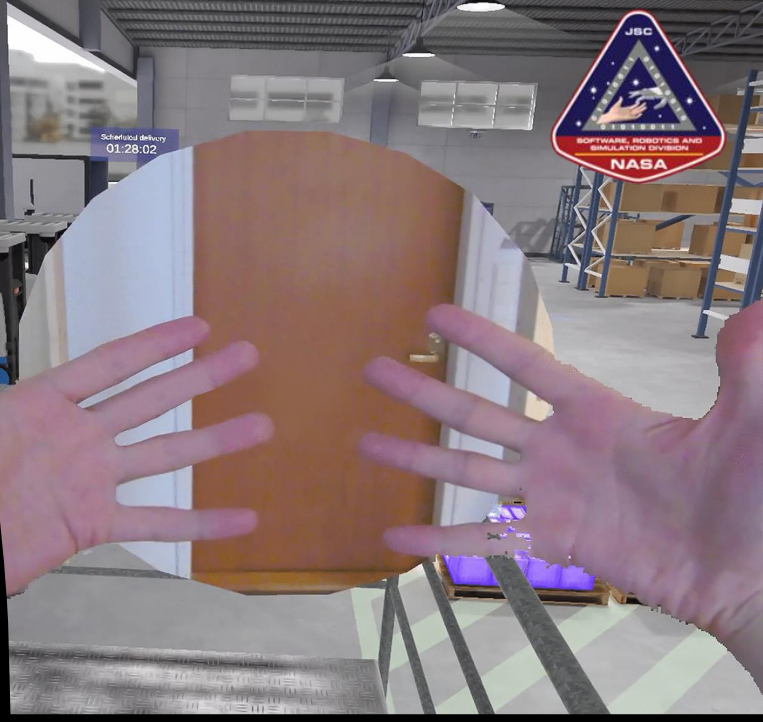
Currently integrating and testing for “short sleeve” XR egress with platform and ladder, Vive pucks with full body tracking (Unity Final IK), and BeBop gloves for Hand and Finger Tracking

VR and ARGOS – CIF Lunar Lander Egress/Surface EVA Project

VR and ARGOS – CIF Lunar Lander Egress/Surface EVA Project



Lunar Lander Mixed Reality Simulation Proposal



An Oculus Quest Mixed Reality Lander Prototype Unity

Forward Leaning XR Related Technologies

- XR for Lunar Surface EVA Risk reduction and Training
  - Analysis of south pole landing sites and lighting/shadows
    - Validation of Sun, Shadows earth shine, rocks and craters
    - EVA and Rover Navigation
  - Move to Unreal for VR – v5.1 & multi-player
  - Integration of XR into Mockups, ARGOS and 6DOF platforms
    - Ascent/lander egress
    - Rovers/Motion Base
  - Mixed Reality with vehicles, tools, rocks and soil
    - MR Lander Trainer
- XR systems for early space vehicle design analysis
- Reliable hand and finger tracking systems
- Inside out tacking systems – Full body
- Onboard XR training and operations systems
  - XR systems that work in space microgravity environments
  - Onboard high performance GPU/HMD designs

Questions?