JSC Engineering Lunar Surface Visualization Work
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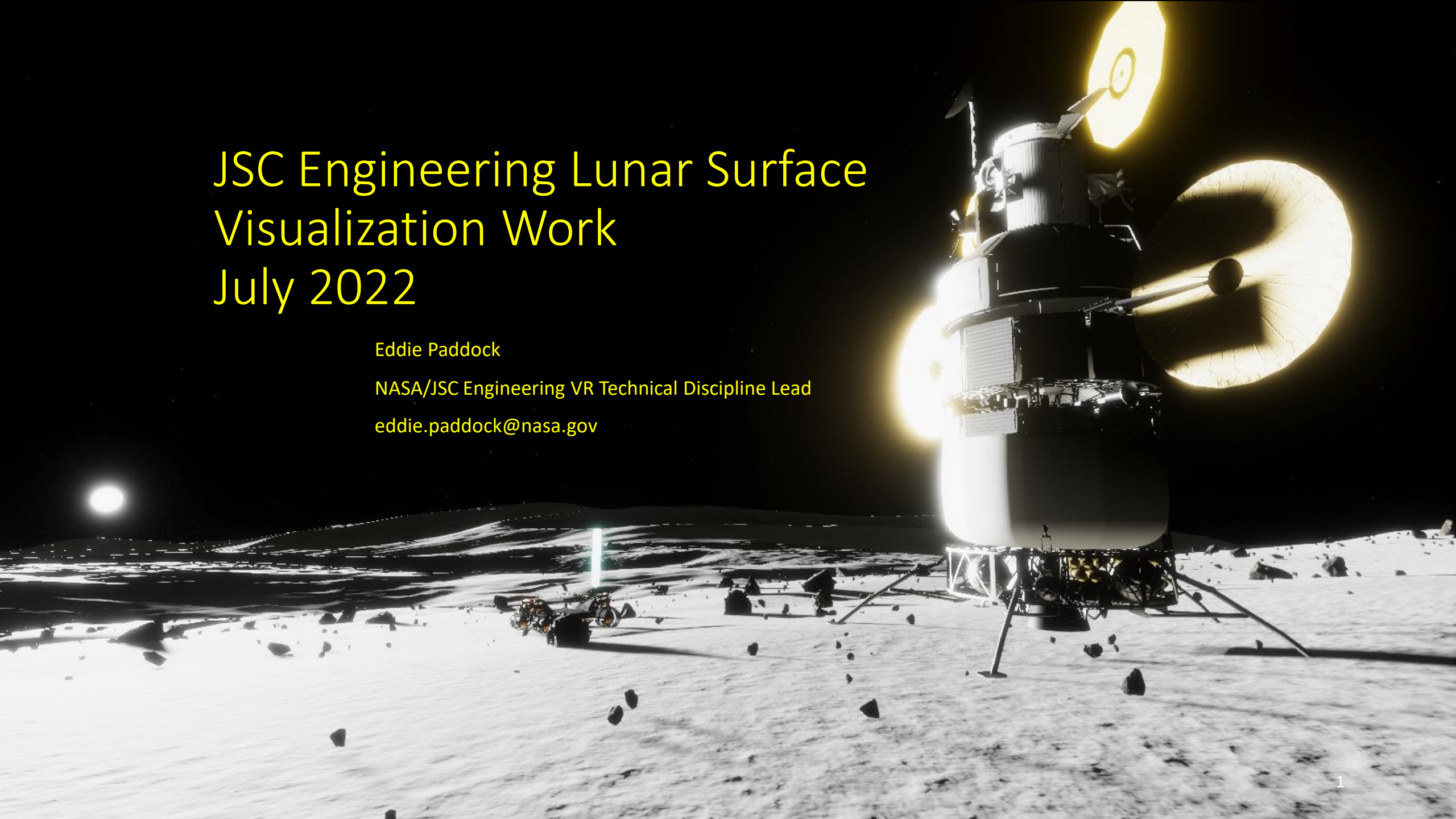
Eddie Paddock

NASA/JSC Engineering VR Technical Discipline Lead

eddie.paddock@nasa.gov



Agenda

- JSC Engineering (ER7) Visualization Team Members
- Overview of Lunar Surface Visualization Work
- Specific Visualization development SW/HDW
- Digital Lunar Exploration Sites (DLES) Visualization Tool (DVT)
- Lunar Surface EVA VR HITL Testing Video
- VR/ARGOS Test Video
- Varjo Mixed Reality Lander Prototype
- Terrain and Lighting Conditions Visualization Validation Efforts
- Questions

JSC Engineering (ER7) Visualization Team Members

- Civil Servants
  - Eddie Paddock – Engineering VR Technical Discipline Lead
  - Lee Bingham – Visualization Lead Engineer
- Contractor Visualization Development Support Team
  - CACI
    - Jeff Hoblit
    - Brad Bell
    - Angelica Garcia
    - Tanner Hunt
    - Anand Patel
    - John Schweers
    - Billy Young
  - METECS
    - Frankie Graffagnino
    - Nick Davis
    - Cory Foreman
    - Jack Kincaid
    - Ben Weno
  - CYFOR
    - Cheyenne Mckeegan
    - Ty Butler
    - Moses Hernandez
    - Chris Raymond
    - Eric Richeson
    - Austin VanBergen
    - Clinton Wallace

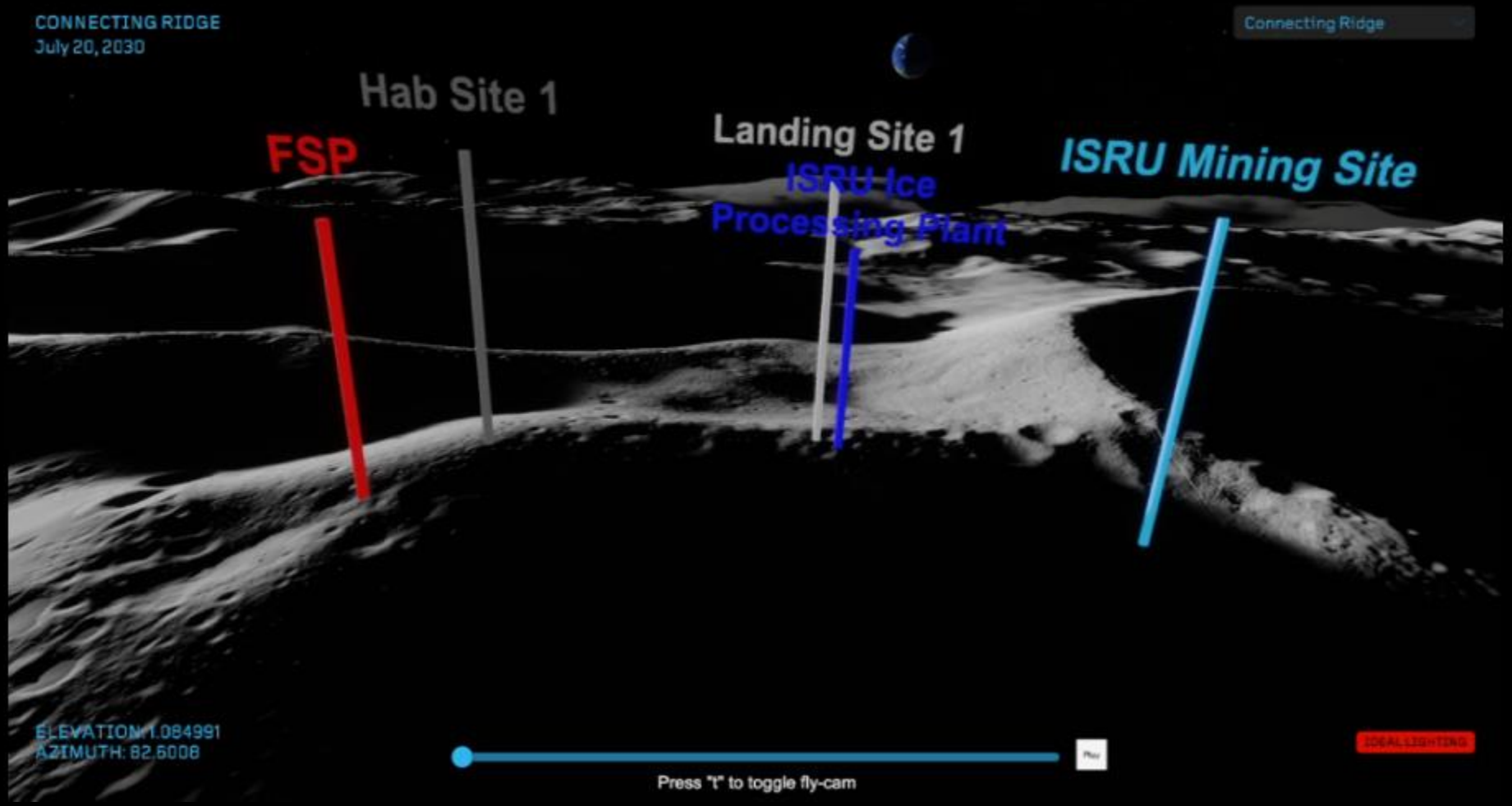
Overview of Lunar Surface Visualization Work

- 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, 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 VR test scenarios for HITL Crew studies including way point traverses, rock inspections and tool use in different location and lighting conditions
- 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

Specific Visualization development SW/HDW

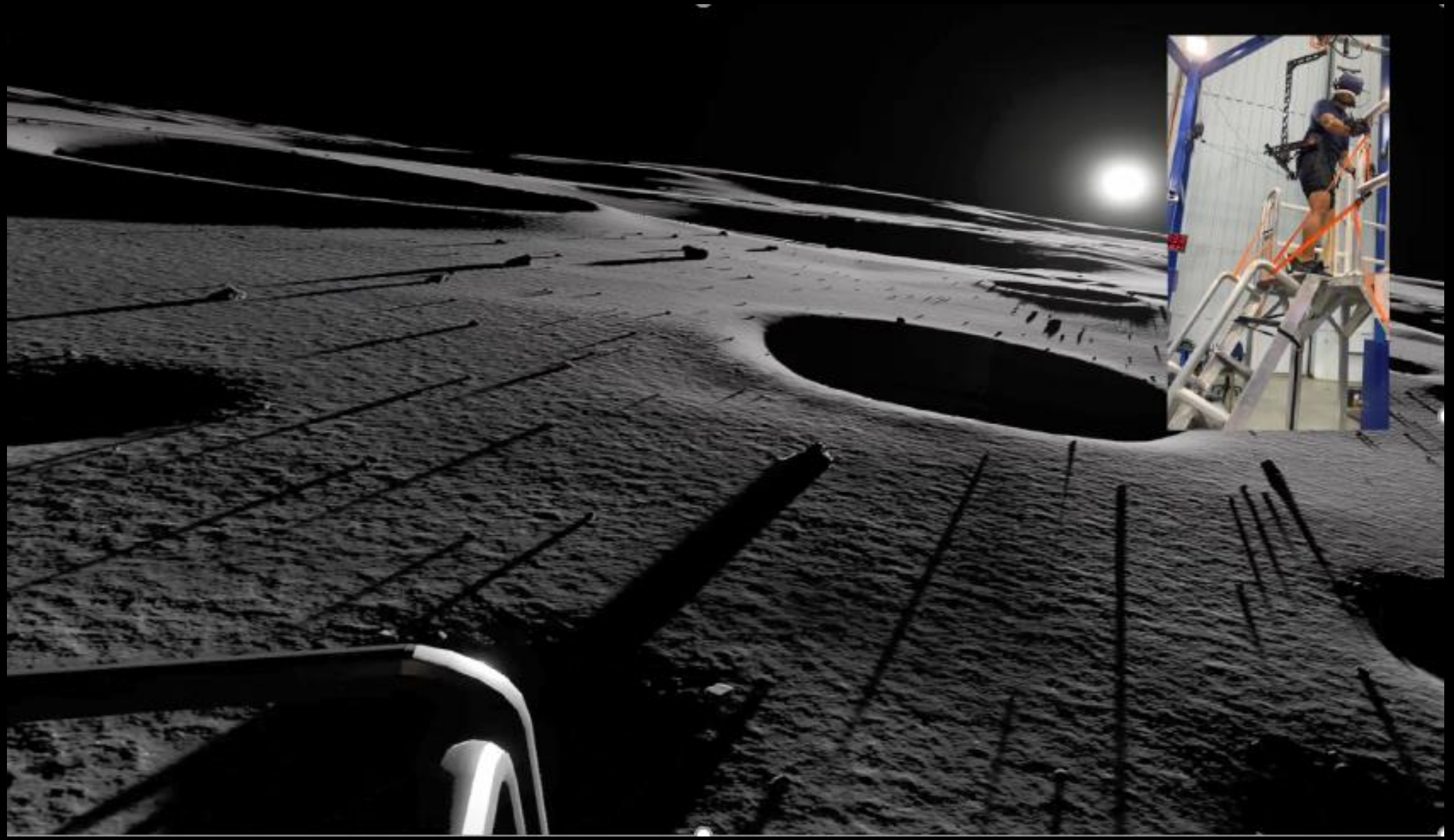
- 3D model processing of DEM data and CAD
  - GDAL, Pixyz, Blender
  - FBX and OBJ formats
- Building up Lunar South Pole VR and desktop visualization software with Unity, Unreal and EDGE
  - EDGE (Engineering DOUG Graphics for Exploration)
    - Home grown 3D rendering tool from JSC
- Using blender processed FBX terrain tiles and/or ingesting geotif 5 meter DEM data directly into rendering engine terrain pipelines
- Developed in-house database for higher resolution synthetic craters and rock distribution integration with rendering tools and DEM data
- Using HTC Vive, Oculus, Varjo, and OptiTrack equipment with Nvidia graphics
- Using Trick/JEOD and JPL/SPICE interfaces for ephemeris and simulation interfaces
- Using Photon for distributed multi-player/client state management

Unity based Digital Visualization (DVT) Desktop Tool

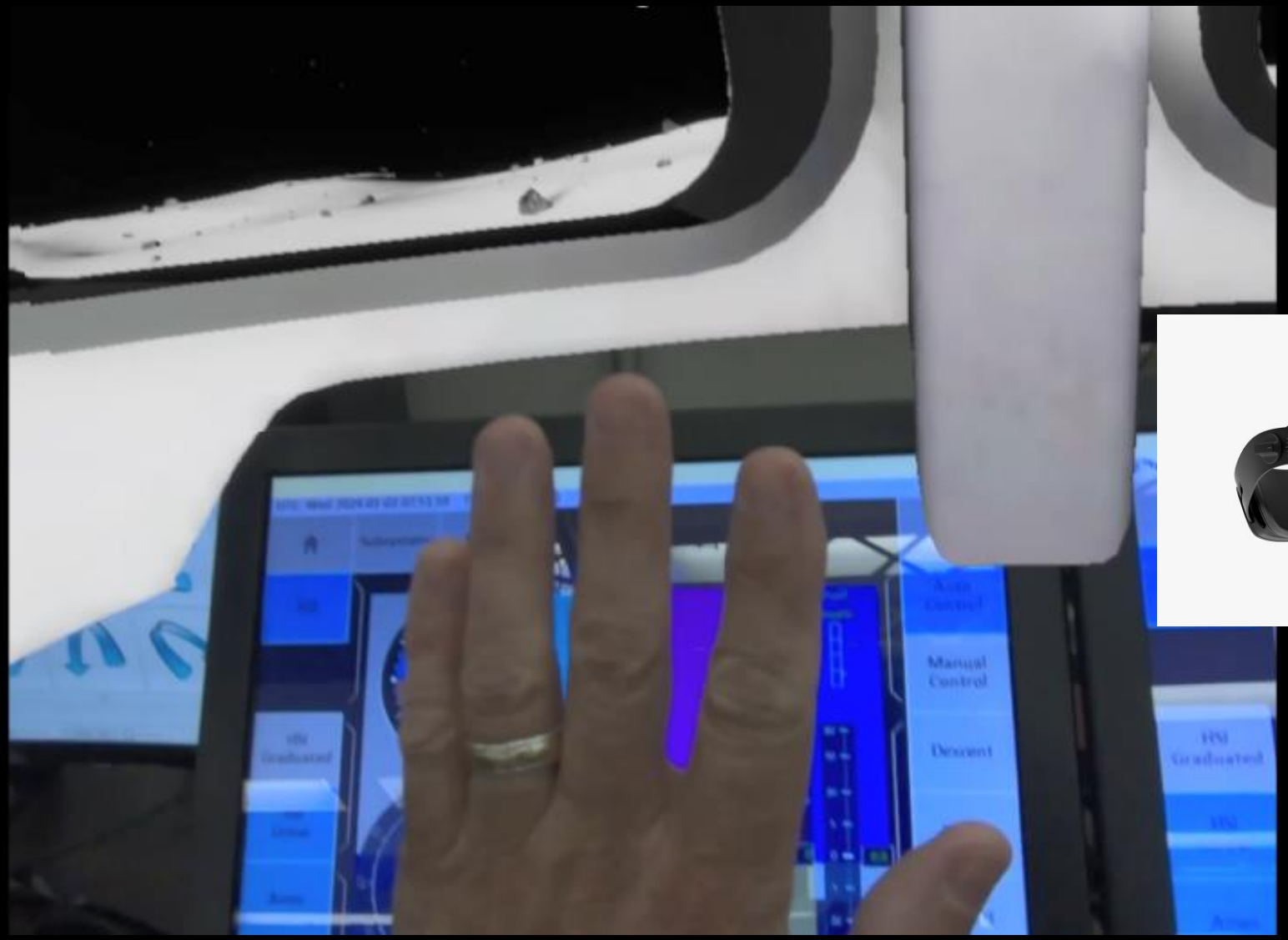


Unity Multi-Client Lunar Surface EVA VR HITL Testing Video

VR/ARGOS Test Video

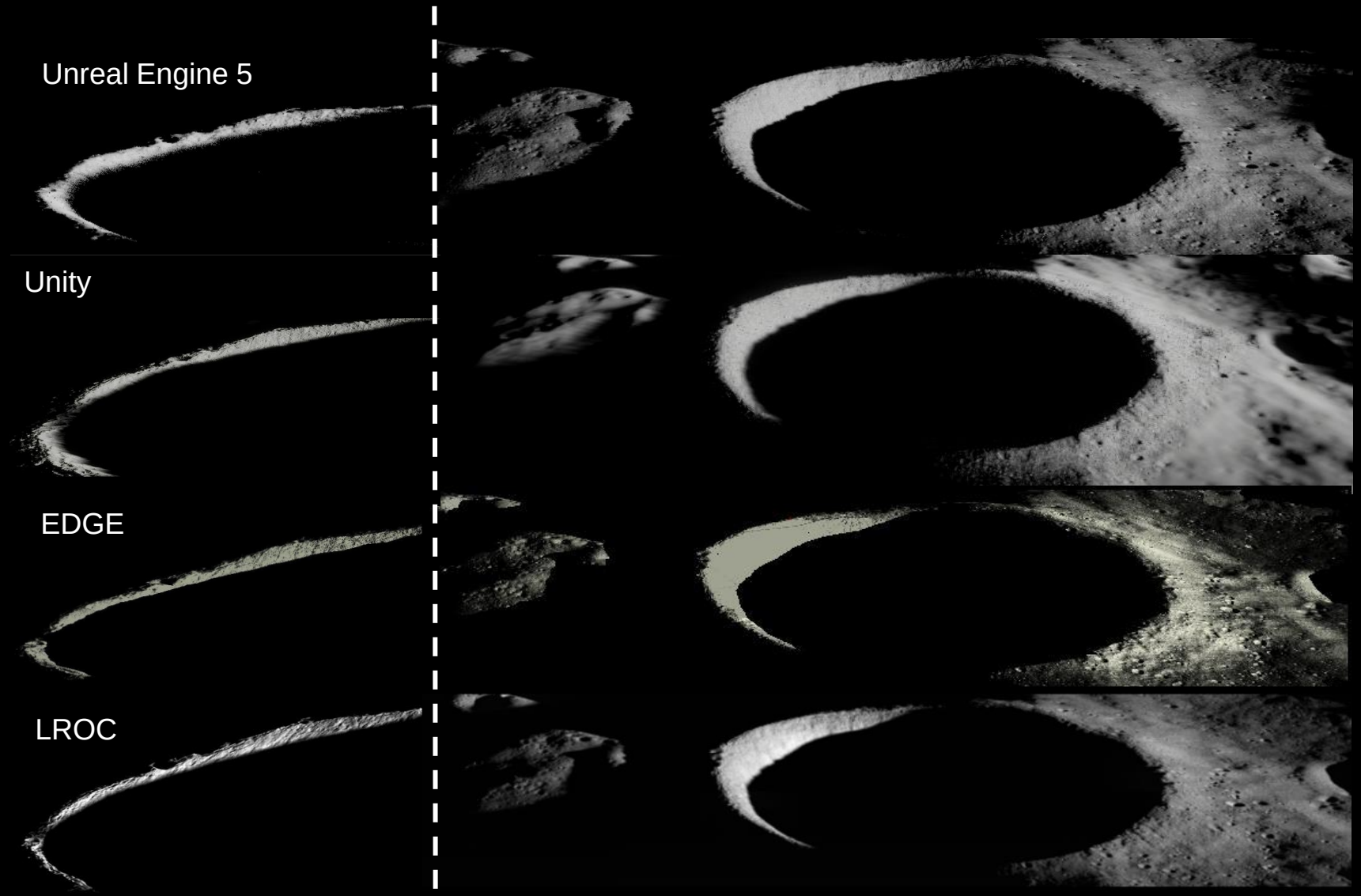


An Overview of Varjo Mixed Reality Lander Prototype - Unity



Terrain and Lighting Conditions Visualization Validation Efforts

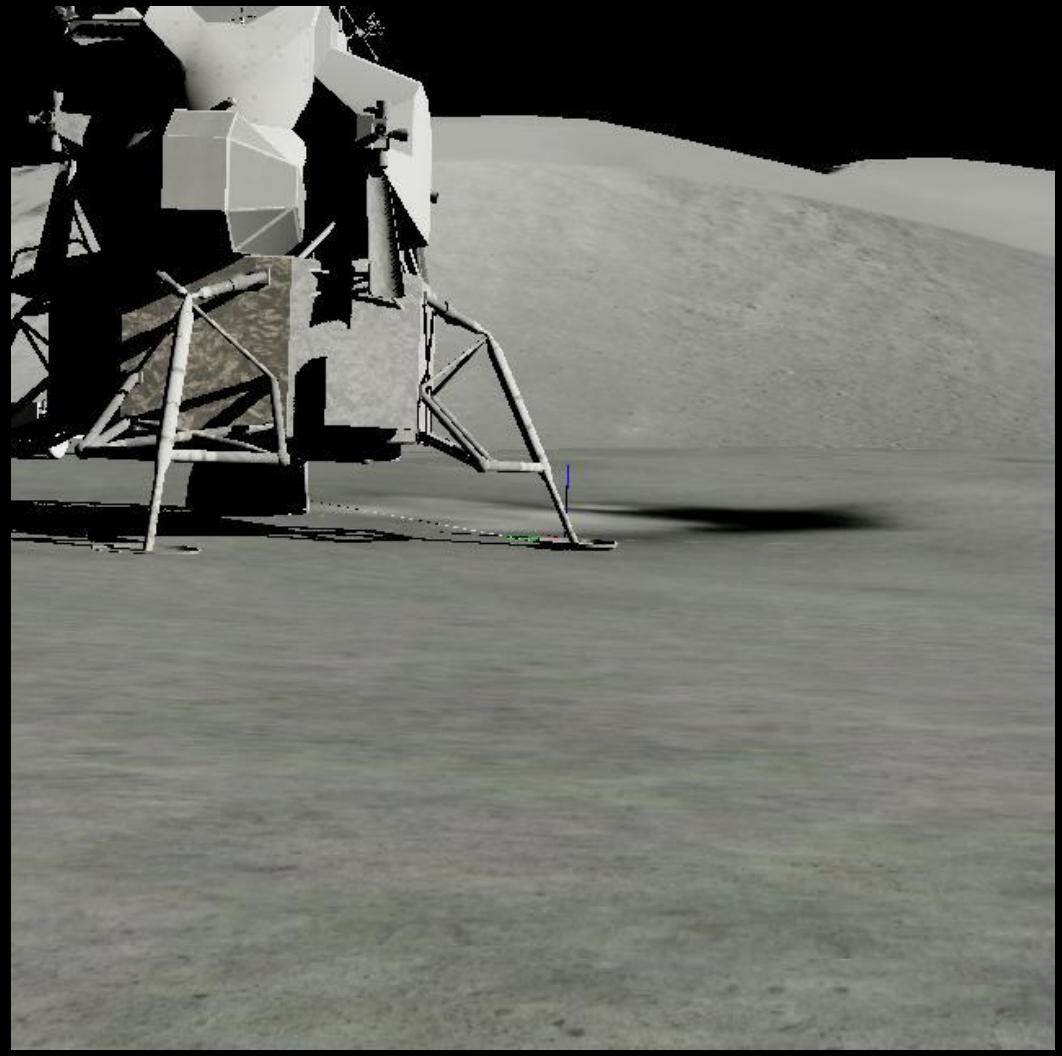
LRO Camera Image to Rendering Engine Virtual View Comparison



Terrain and Lighting Conditions Visualization Validation Efforts

Also Working other Apollo 17 and 12 Camera Image Comparisons

Apollo Image



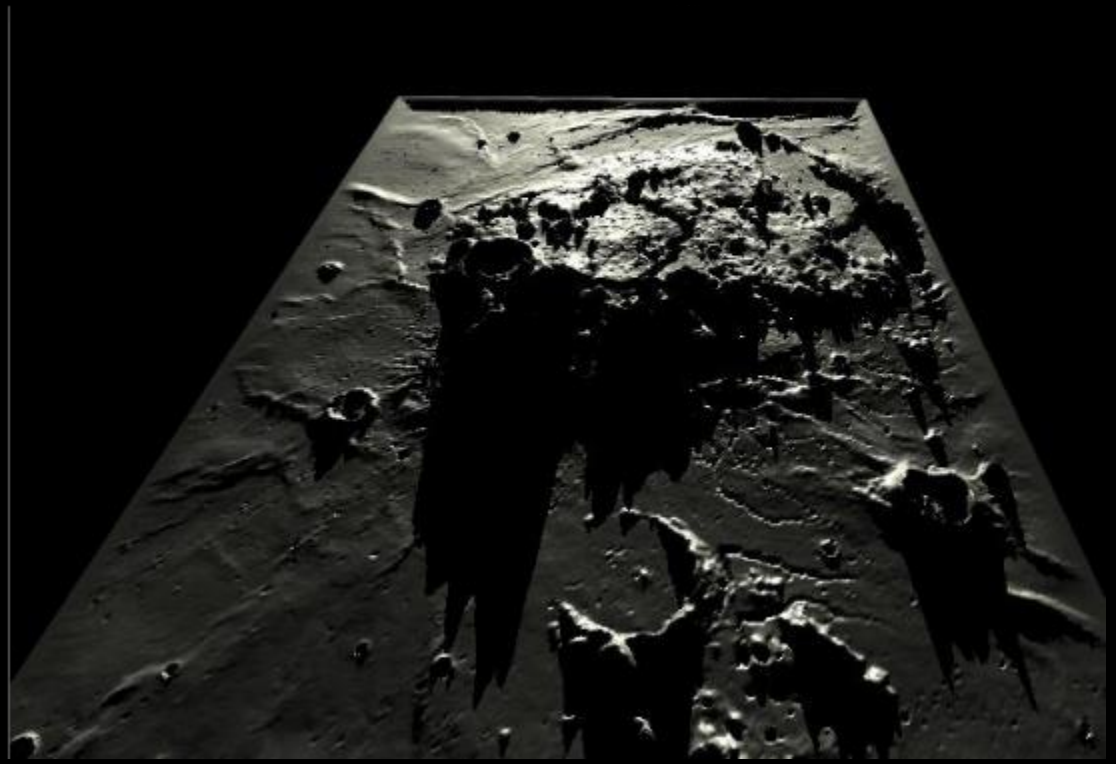
EDGE Image

Terrain and Lighting Conditions Visualization Validation Efforts

Also Working Comparisons to Lighting Lab Tile Study (Rob Grover/JPL)

JSC Lighting Lab Image

EDGE Rendering



Questions?

Backup

- Unity vs Unreal vs EDGE
  - Unity
    - C#, easy to learn, lots of examples and tutorials (interns seem to pick up quickly), more widely used in commercial industry, AR HMD support, lots of assets and plugins, easy to set up VR locomotion, Photon (PUN) interface for multi-player, Easy to implement VR locomotion and PhysX, FinalIK inverse kinematics, Unity ready tools for OptiTrack, Varjo, VR gloves, etc., mobile applications ios/Android, web, and cross platform deployment
  - Unreal5
    - C++, blueprints, Free for development, double precision (new to v5), ray tracing, better realistic look for materials, Nanite Virtualized Geometry, Lumen Dynamic Global Illumination and Reflections and World Partition
  - EDGE/DOUG (Engineering DOUG Graphics for Exploration)
    - General Public Release through NASA SUA, Double Precision, External simulation interfaces for dynamic interaction between math models and graphics, Facility support for multiple client configurations, synchronization, windows, displays and dome projection systems, plugins, scripting, data recording/playback, built in camera features, VR and desktop, Linux and Windows