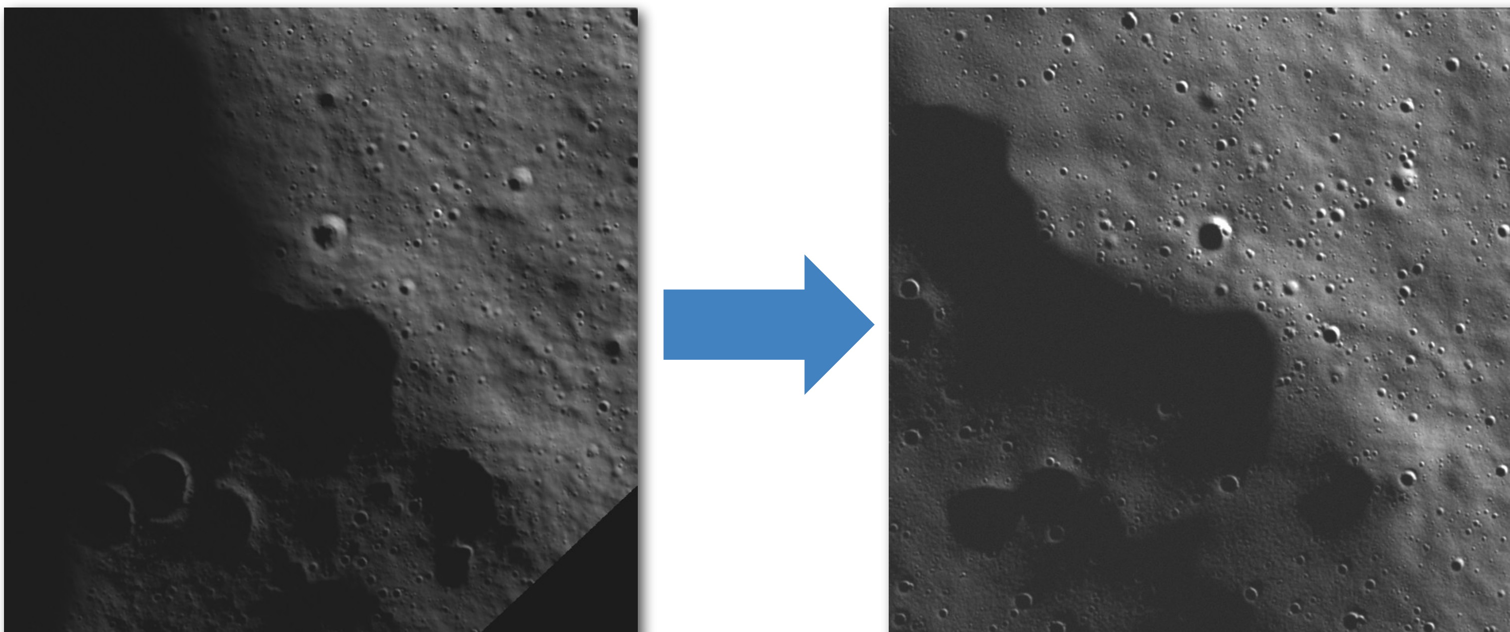
Synthetic DEM Generation Process

1. LROC-NA Images and LOLA laser altimetry of the Hermite A region
2. Create initial DEM with 1 m/post using photoclinometry
3. Synthetically enhance DEM via fractal synthesis to create high-resolution surface detail that is consistent with lunar morphology
4. Add synthetic craters and rocks using a parametric shape model with size-frequency distributions to control density

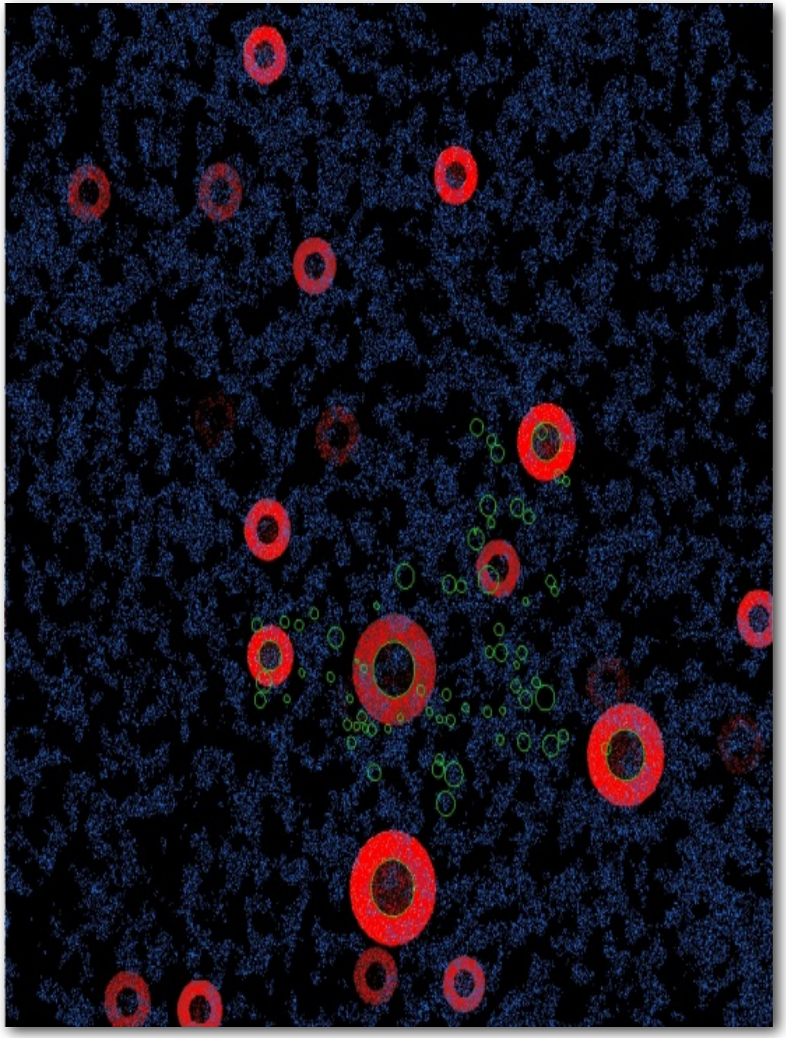


Crater Placement

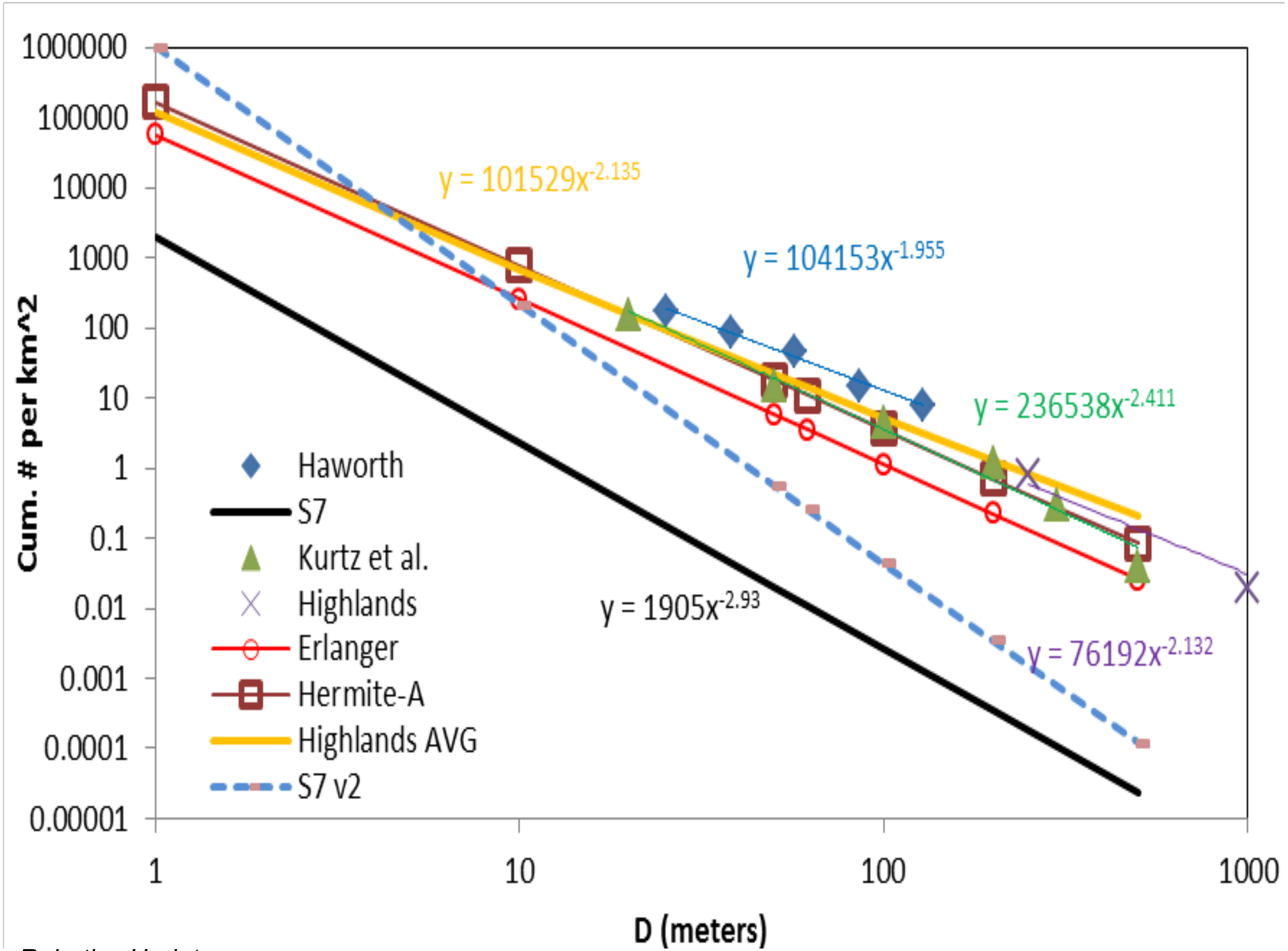
Approach

- Spatially uniform, random locations
- Older craters are slowly “overwritten” by newer (fresher) craters
- Larger new craters “overwrite” smaller old ones
- Smaller new craters excavate into larger old ones

Craters can also be manually placed to match orbital imagery



Crater Size-Frequency Distribution



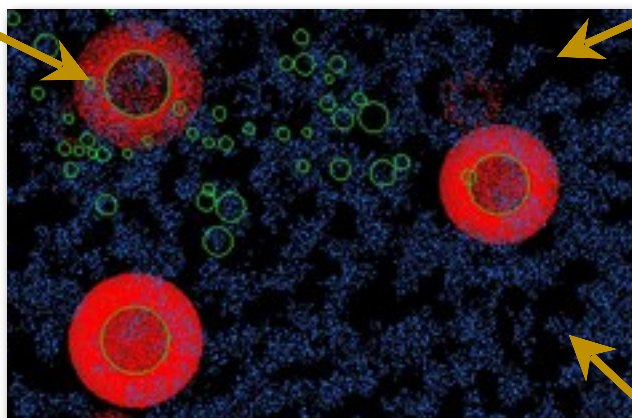
Rock Placement

Approach

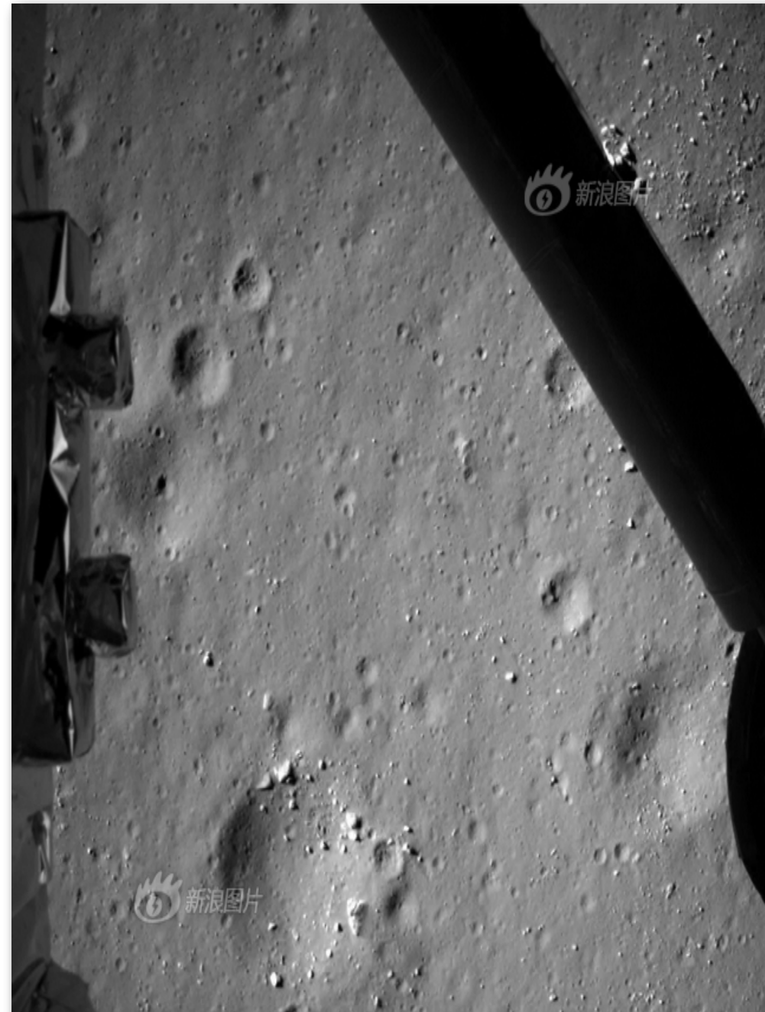
- High density near fresh crater rims
- Low density between craters
- Random “clumping” parameter applied to control spatial uniformity
- No attempt to model ejecta rays

Crater Ejecta

No rocks

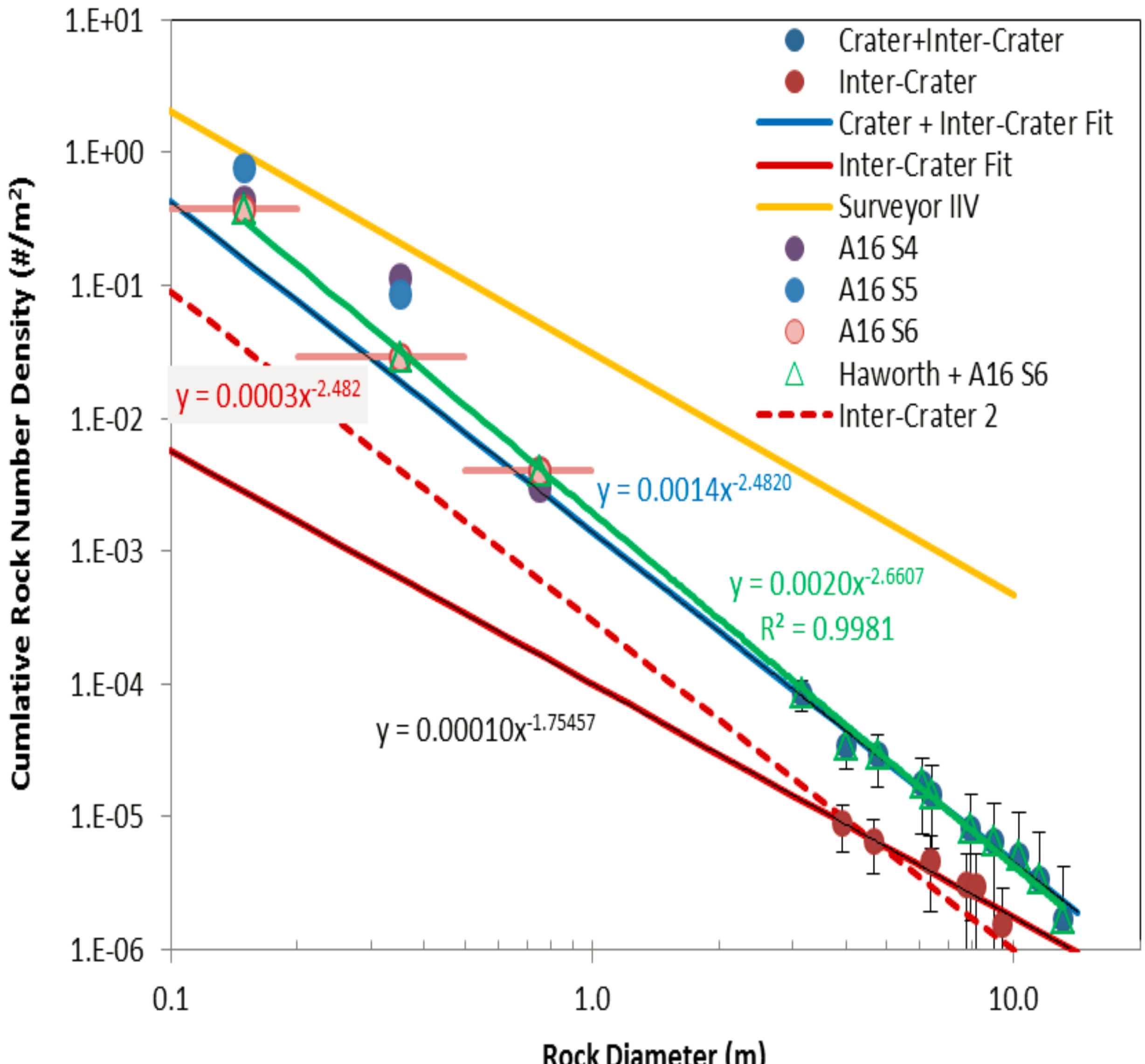


Inter-crater rocks



Chang-e descent image

Rock Size-Frequency Distributions



Synthetic Terrain Results

Synthetic Terrain Results

Synthetic Terrain Results

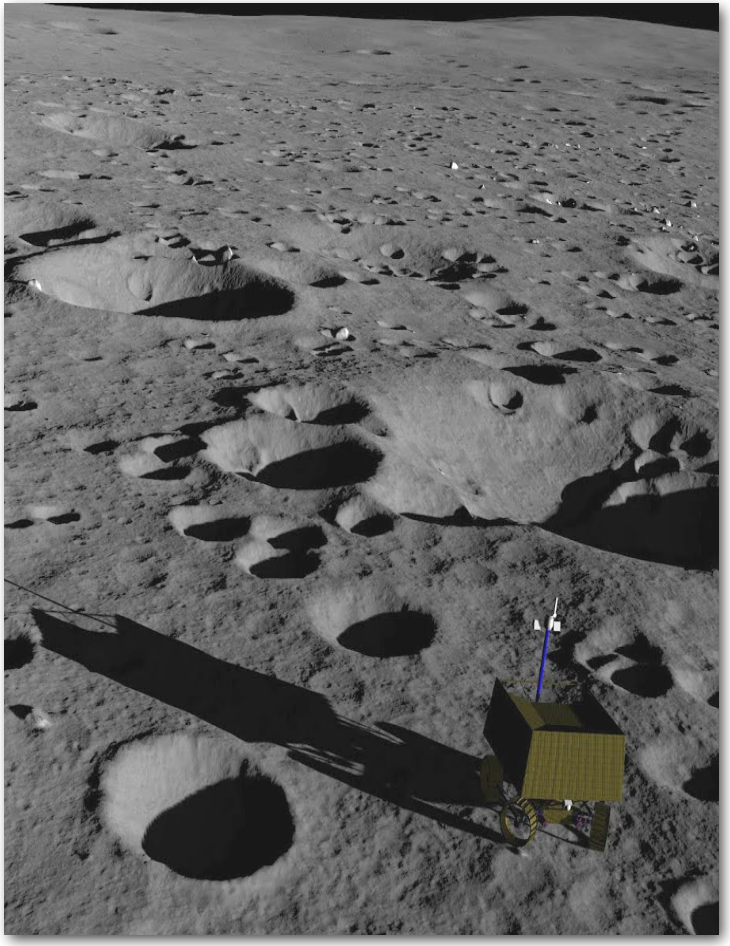
4. Lunar Surface Simulator

Need

- Real-time simulation for conops studies and engineering (“plausible fidelity”)
- Provide high-quality 2D/3D data to operator interfaces, rover software modules, science displays, etc.

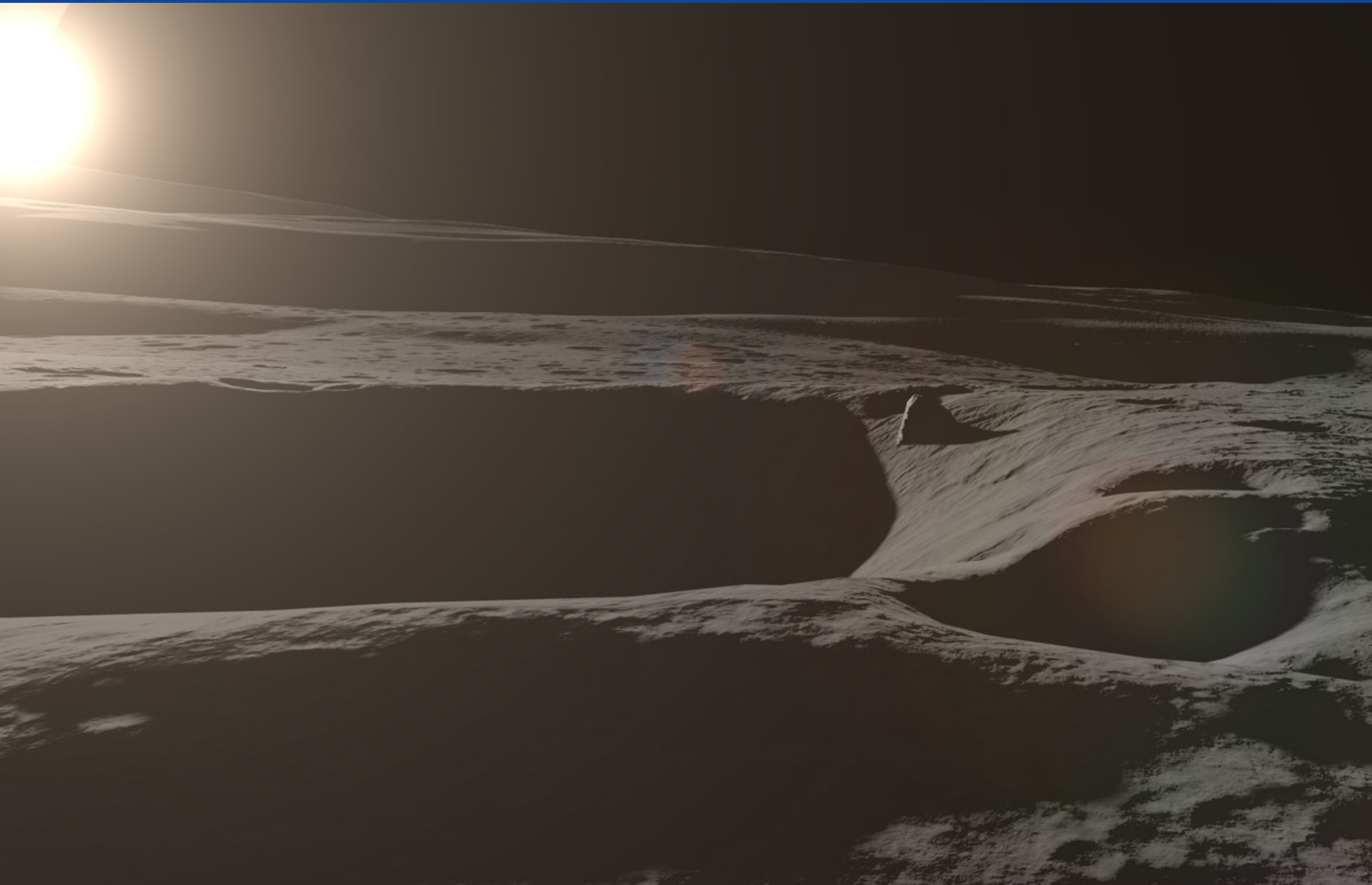
Features

- High dynamic range rendering
- Real-time shadows
- Support for high resolution terrains
- Support for custom terrain appearance
- Rover wheel tracks and slip modeling
- Rover lights with custom beam pattern
- Simulated lens flare and camera noise
- Lunar regolith reflectance model (Hapke)
- Accurate Sun & Earth location (SPICE)

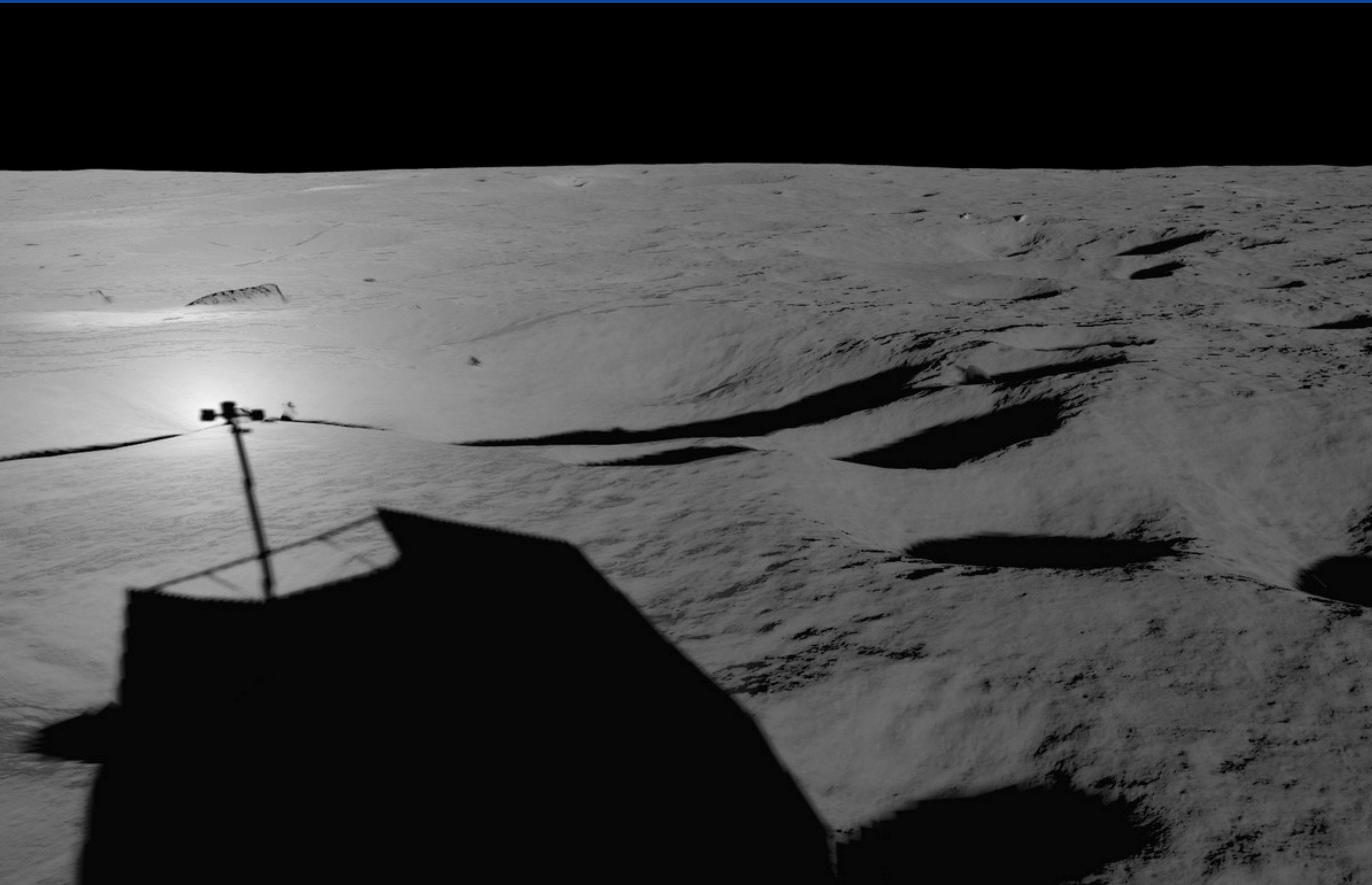


Lunar surface simulator based on “Gazebo” robot simulator (Open Source Robotics Foundation)

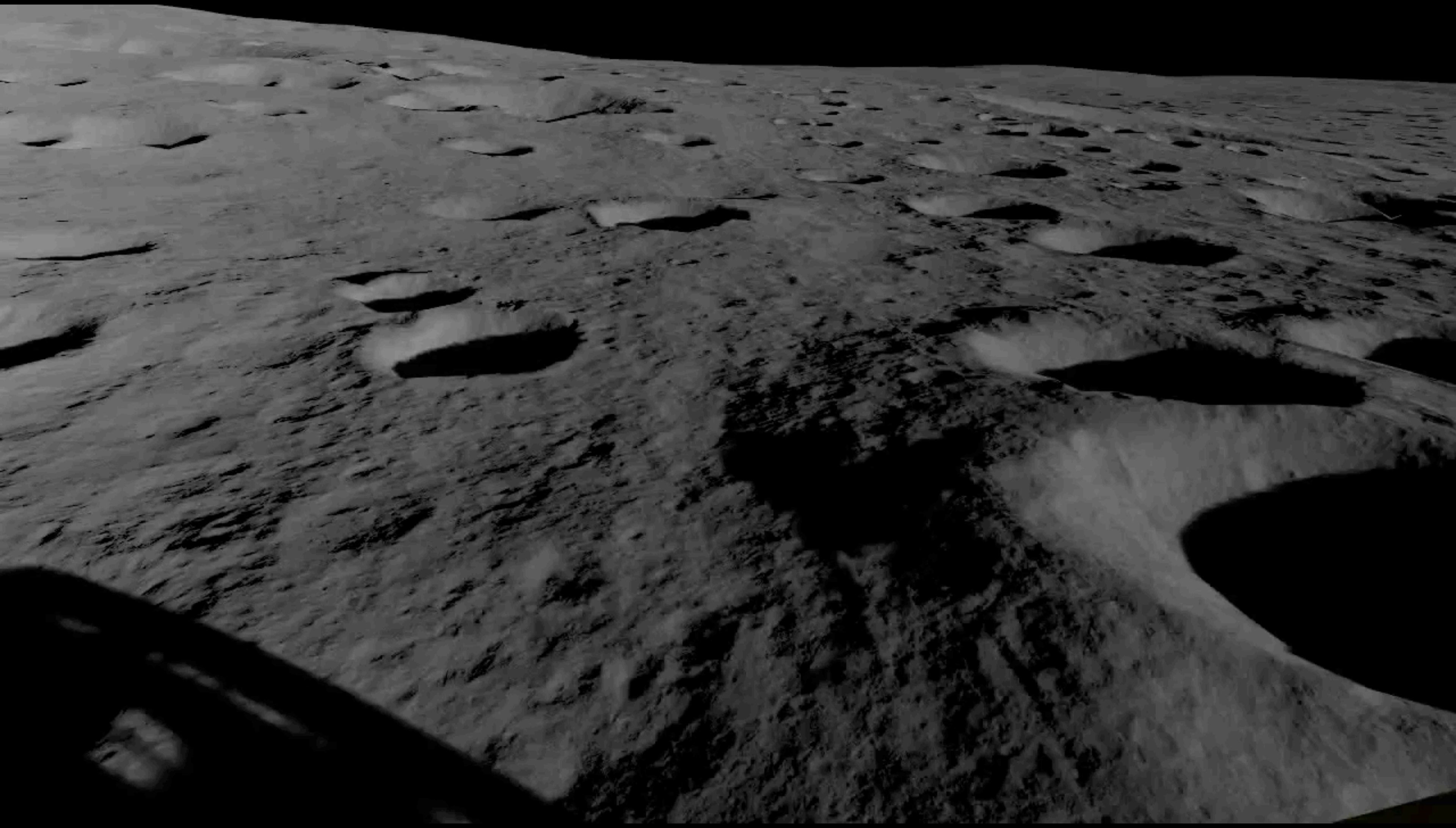
Lens Flare



Opposition Surge



Long Cast Shadows



Questions?

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