Celestial Mapping System for Lunar Surface Mapping and Analytics

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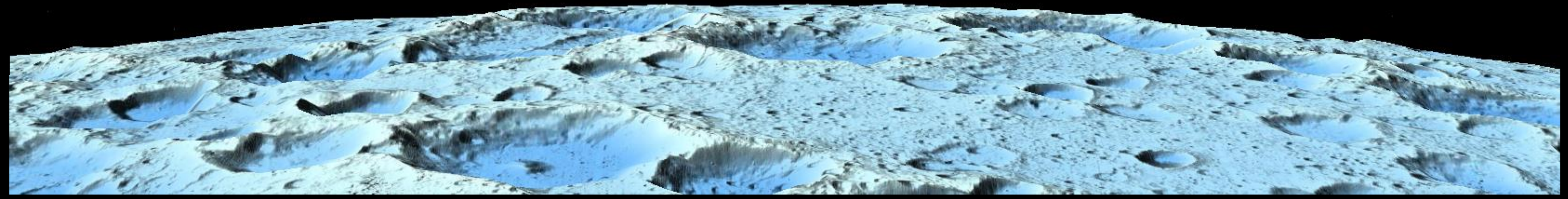

Fig. 1. 3D terrain with LOLA Color Shaded Relief Blue Steel derived from LRO elevation data

Background

Celestial Mapping System (CMS) is a software platform to generate virtual 3D globes for celestial bodies. Various layers are built on top of the virtual globe to provide visualization of high-resolution imagery, enable precise measurements, build analytical capabilities and provide a broad range of functionalities.

CMS supports importing synthetic features in a variety of 3D, 2D, vector and raster formats. It will run on a wide variety of platforms such as Linux, Windows, and OSX.

The present focus of CMS is on developing lunar mapping tool kits to provide features such as: 3D first person view with zoom and navigational capabilities, realistic terrain visualization, measurement tools, Apollo landing site annotations, stereoscopic view, elevation profiles, line of sight analysis and many more.

Key Attributes

- Path conforming Lat-Lon and GARS graticules to provide accurate analysis of the lunar surface (fig. 8/9).
- Stereo view brings out craters and prominent features (fig. 5).
- Support for integrating 3D objects to simulate rovers, cislunar satellites, and landing vehicles.
- Broad range of visualization & analysis functionality for 3D globe view.
- Path conforming measurement toolkit.
- Dedicated server to integrate high-resolution imagery and data from recent missions.
- Display of geodetically accurate LRO LOLA Shaded Relief maps at 473mpp, 388mpp, and 237mpp.
- Global elevation data derived from LRO LOLA DEM with a resolution of 118mpp.
- Lunar parameters derived from the standardized IAU2000 Moon spatial reference to ensure accurate distance and measurements.

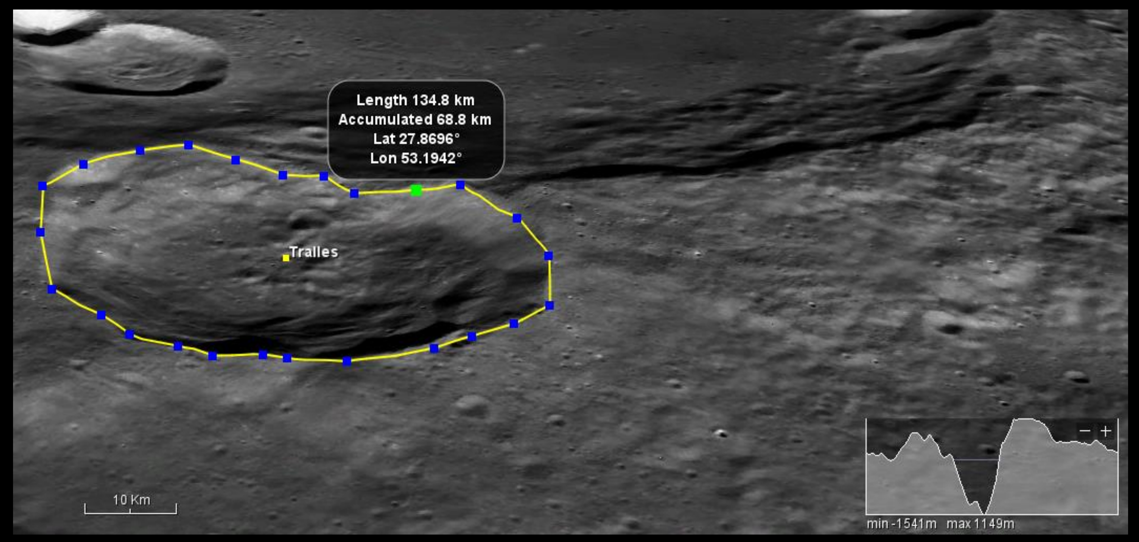

Fig. 2. Measuring area of irregular crater Tralles

Fig. 3. High-res view of Apollo 15 with 3D astronauts and craft

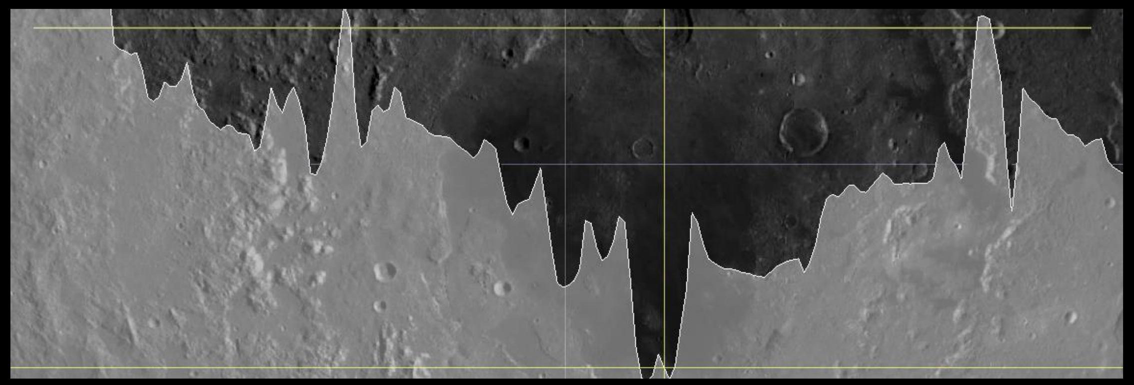

Fig. 4. Analyzing the elevation profile of Mare Orientale

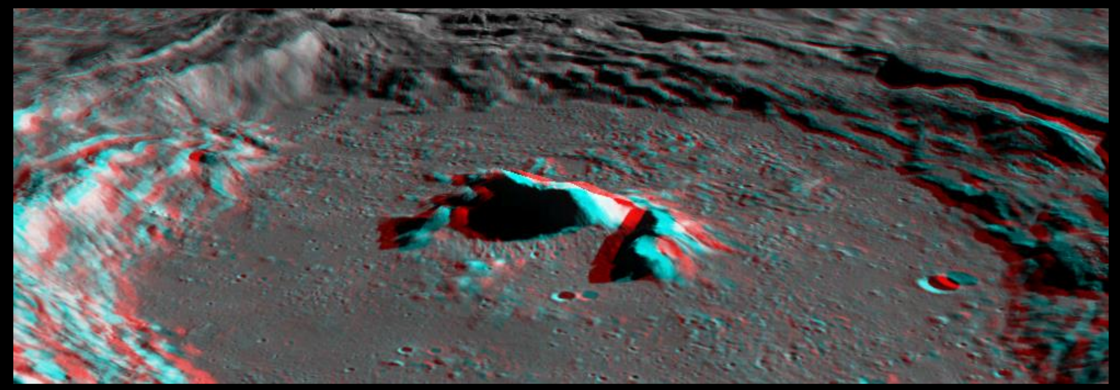

Fig. 5. Displaying a mountainous crater in stereo view

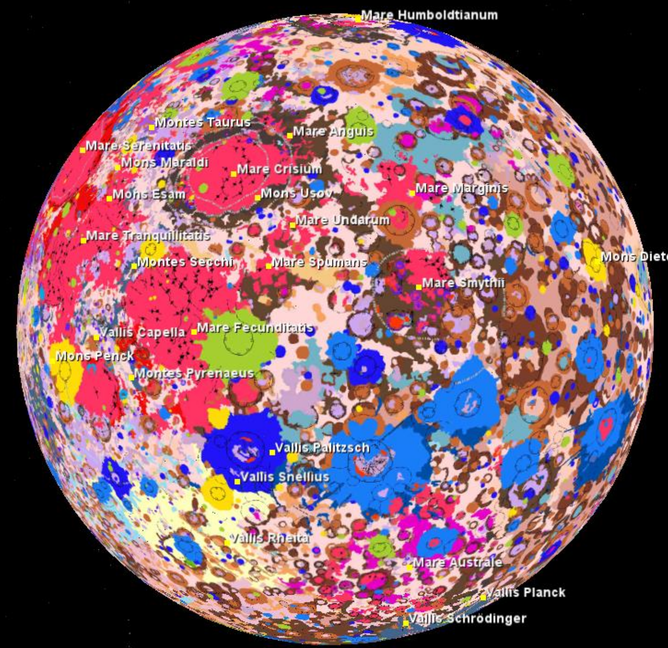

Fig 6. Unified Geologic Map of The Moon – 2020 version

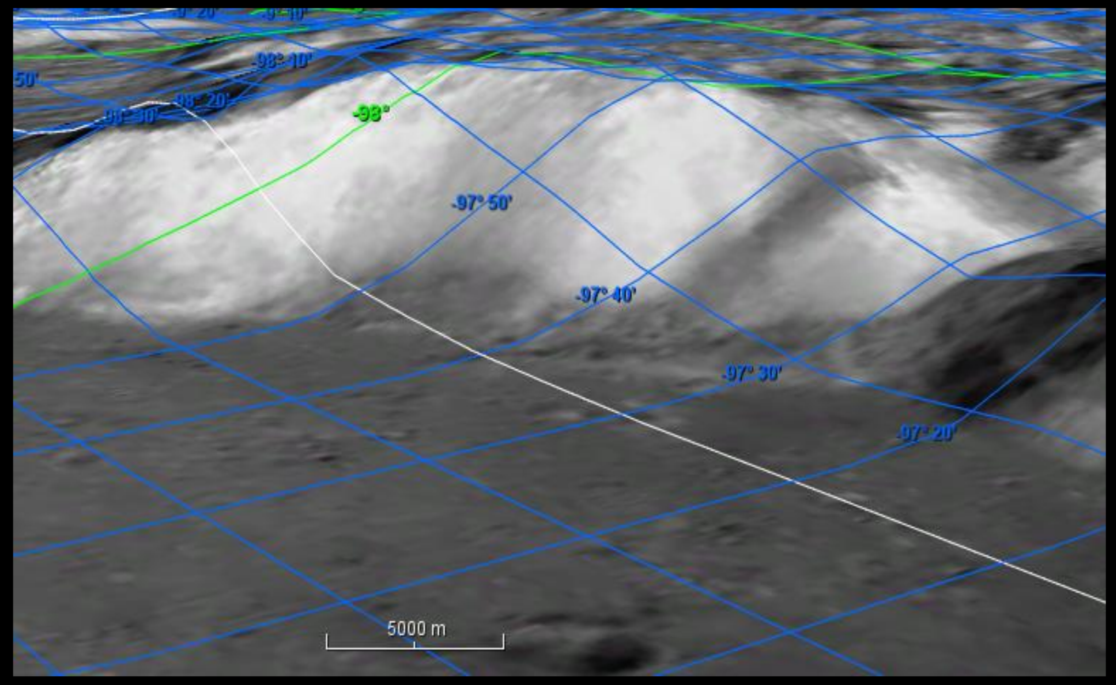

Fig 7. Lat-Lon graticule conforming to mountains

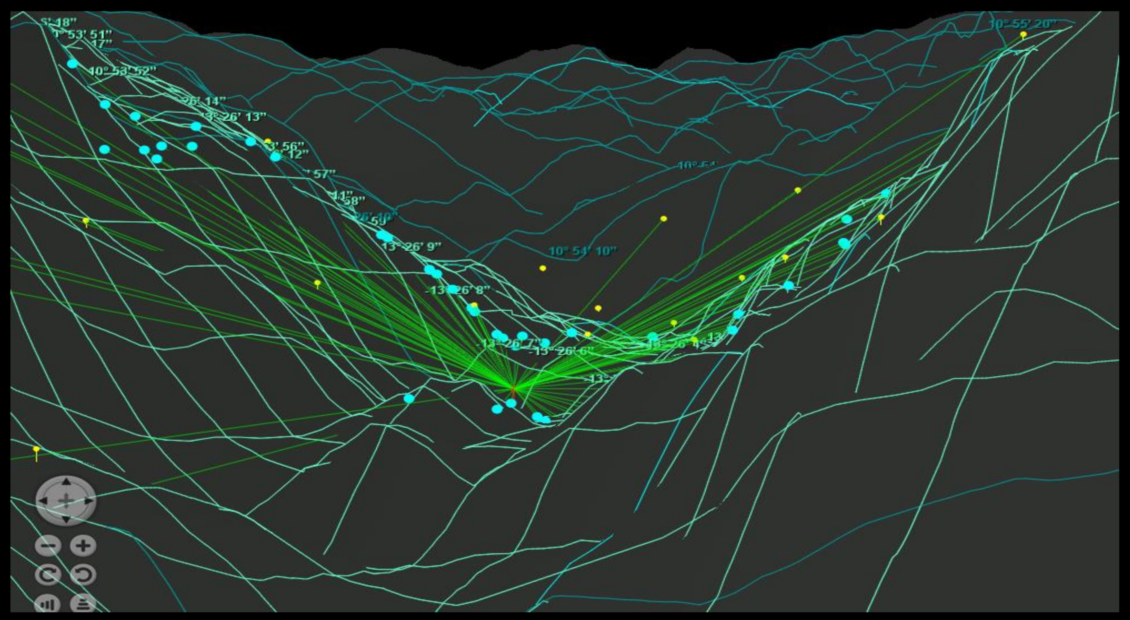

Fig 8. Line of sight analysis inside a crevice

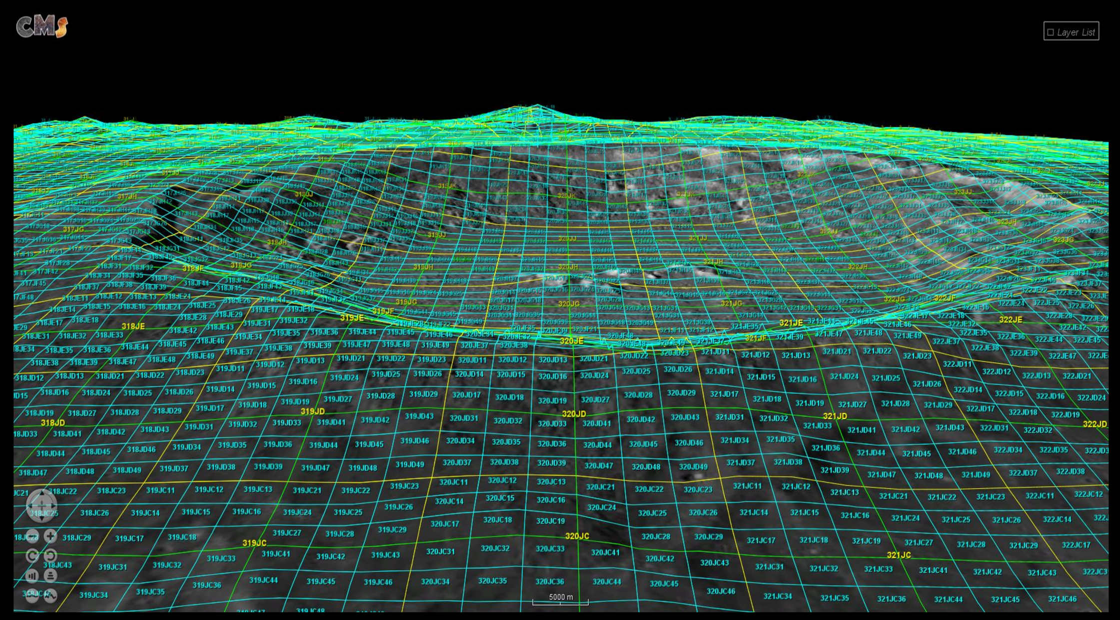

Fig 9. GARS graticule over Copernicus crater

Current Capabilities

- Accurate display of lunar surface and terrain at 100mpp.
- Accurate lunar measuring and calculations (fig. 2).
- Accurate display of lunar place names.
- Ability to display and measure geometric figures.
- Interactive viewing of Apollo landing sites with georeferenced imagery at 20mpp, 3D craft, and annotations (fig. 3).
- Views for stereo, 2D, and 3D.
- Ability to calculate and display lunar terrain profiles (fig. 4).
- Navigation capabilities; view controls, scalebar, and graticules.
- Line of Sight Analysis (fig. 8).

Verification & Validation

- Distance and area calculations from the measurement toolkit and terrain profiler were compared with other lunar applications to ensure accuracy.
- Elevation data was compared with LRO LOLA DEM using QGIS identify features to ensure accuracy of values.
- GDAL (Geospatial Data Abstraction Library) was utilized to analyze datasets.

Future Applications

- Situational and domain awareness for first-person viewing.
- Moon shading/illumination simulation & calculations.
- Subsurface visualization & analysis.
- Search and fly-to functionality.
- Resource assessment.
- Simulation of cislunar satellites.
- Planning capabilities for equipment placements and traverse path optimization.

References

WorldWind, https://worldwind.arc.nasa.gov/
USGS, https://astrogeology.usgs.gov/
LROC, http://wms.lroc.asu.edu

Ames Research Center

Lunar Surface Innovation CONSORTIUM