WILL IT BLEND? UPDATES IN PLANETARY VISUALIZATION: THE SEQUEL L. M. Davis[1] and V. H. Silva, N.M. Estes, and the LROC Team, School of Earth and Space Exploration, Arizona State University, Tempe, Az1 (ldavis@ser.asu.edu)

Introduction: The Lunar Reconnaissance Orbiter Camera (LROC) Science Operations Center (SOC) adapted Blender procedures, an open-source 3D modeling and animation program [1], to decrease rendering time and memory use when producing animation using regional and global digital terrain models (DTMs) [2], compared to our previous DTM import procedure. The process of rendering realistic spacecraft movement achieved with position information from Spacecraft and Planetary ephemerides, Instrument C-matrix and Event (SPICE) kernels [3] was also included in our workflow.

Adaptive Subdivision: Adaptive subdivision is part of the experimental features set in Blender. This feature controls the "Subdivision Surface" modifier in the Blender user interface. While the default "Subdivision Surface" modifier uniformly segments a fixed plane into a flexible mesh, the experimental adaptive subdivision more densely segments the plane in the foreground relative to the background, resulting in fewer segments to process, thus decreasing the memory and computation resources necessary to render a scene. While animation created with the original DTM import procedure could take up to 1200 CPU hours to render on a single high-powered workstation, scenes with DTMs imported and segmented with adaptive subdivision render twice as fast , and memory usage is cut by up to 60%. In order to reap the increased rendering speed possible through utilizing adaptive subdivision, elevation is applied to a mesh through the "Node" editor, instead of using the "Displacement" modifier [4].

SPICE Integration: Realistic spacecraft motion is provided by a Blender add-on developed by the LROC team, which interfaces with the ancillary information system SPICE. The SPICE add-on performs the necessary calculations and frame transformations required to make spacecraft position and orientation data accessible to Blender objects. SPICE position and orientation can be applied to multiple objects in the same scene. The user has the flexibility to select any kernel-supported mission ephemeris time, and have motion data distributed evenly over a user-specified frame range contained within the SPICE kernels. Since the add-on can be used for multiple objects in the same scene, SPICE integration is achievable for any body or spacecraft supported by SPICE kernel files. Multiple SPICE-integrated objects in one Blender scene useful for animating interaction between bodies or spacecraft.

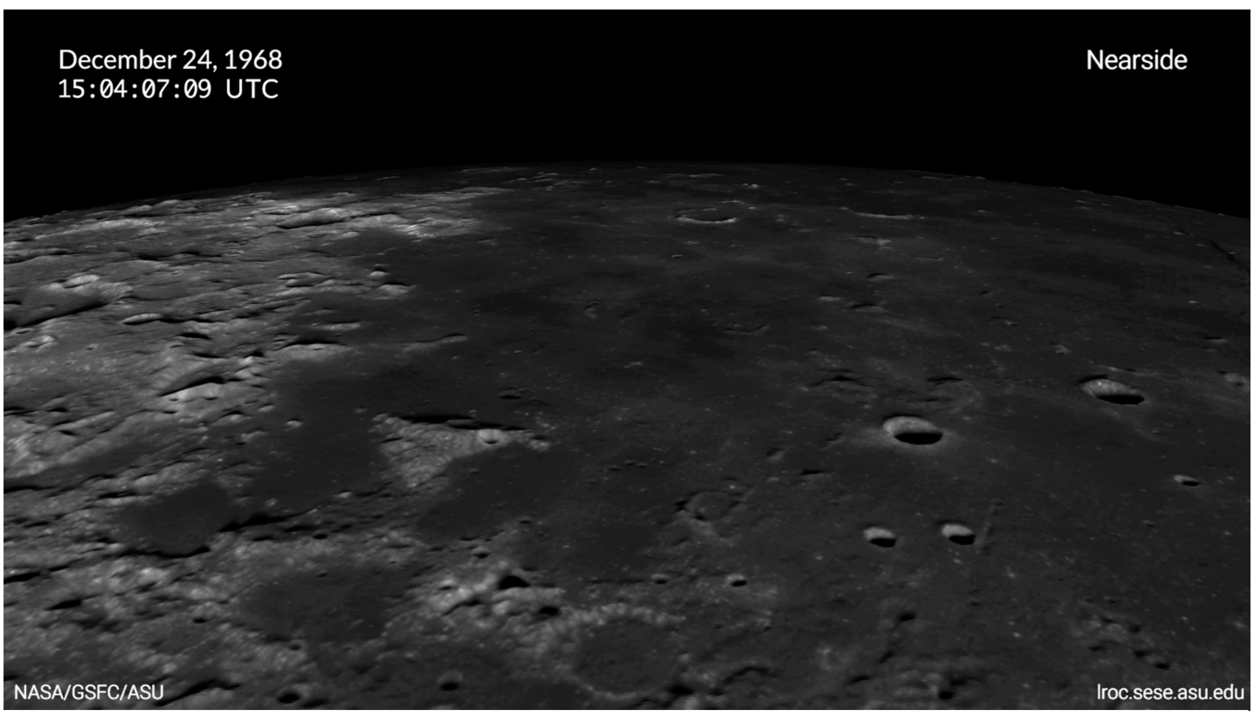

Figure 1: Sample frame of video produced with reconstructed telemetry showing an astronaut's eye view over the lunar surface as seen from the Apollo 8 Command Module at 1968-12-24 15:04:07 UTC as imported from SPICE into Blender.

Results: Adaptive subdivision and the SPICE add-on enabled the LROC team to continue production of a series of educational videos that explain geologic concepts and recreate historical milestones in space exploration.

Future Work: The LROC team plans to continue create animations and still frames with DTMs in Blender. Upon the release of Blender 2.8, the LROC team will utilize BlenderGIS, an add-on that imports geographic data into Blender. Presently, BlenderGIS is limited to Earth-based data; however, once BlenderGIS is adapted to import other planetary datasets, producing animations with DTMs in Blender could be further simplified.

References: [1] Blender Foundation, 2016. [2] Davis L. M. et al. (2017) Planetary Data Workshop, Abstract #7073. [3] Acton, C. H., (1996) PSS, 44(1):65. [4] Balcerski, J., personal correspondence.

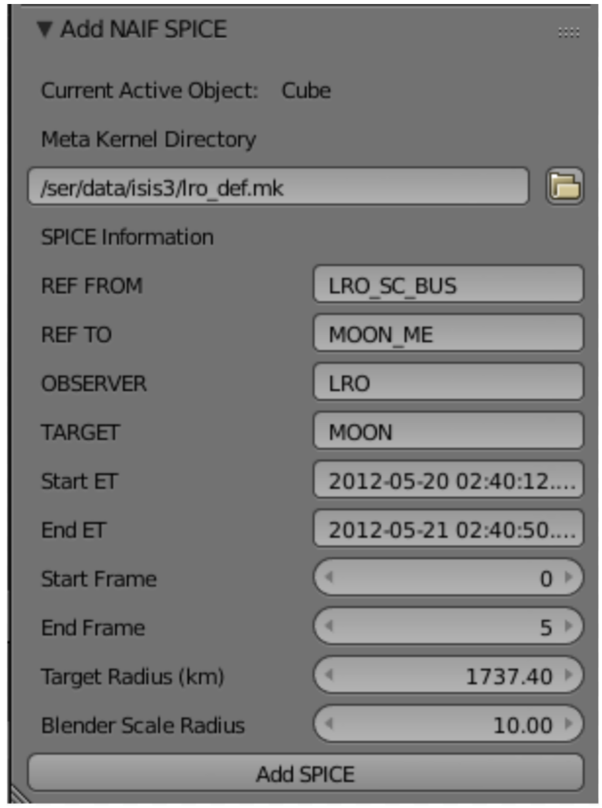

Figure 2: Screen capture of the SPICE add-on in the Blender user interface