Bringing the Lunar Shadowed Regions to Light with Real Time Rendering in Unreal Engine

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INTRODUCTION

Unreal Engine (UE) is a powerful, real time physics based rendering engine. It is most well known for powering the game Fortnite, but UE4 is being used for an increasingly diverse suite of projects in architecture, film, and several research-based uses. A list of publications that have used UE4 for scientific research is maintained at https://ue4research.org/publications.

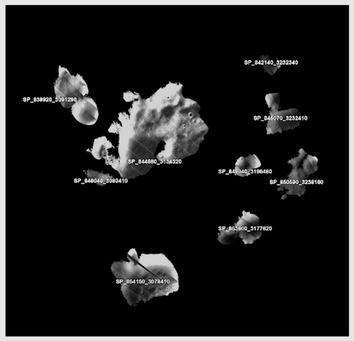

Figure 1. Stretched LROC NAC images of PSRs in Cabeus crater. Image credit: NASA/ASU.

UE4 is well suited for visualizing planetary environments, rendering and exploring potential landing sites, and importing spacecraft CAD models for landers, habitats, vehicles, and more.

The case study shown here is based on the polar environment at the Moon, where harsh lighting conditions and areas of permanent shadow make terrain visualization particularly challenging. Often the only views are overstretched NAC images that are stitched together (Fig. 1).

CASE STUDY: SVERDRUP CRATER

Figures 2-7 show an example workflow of developing a basic scene in UE4, in this case, Sverdrup crater at the south pole of the Moon is used, an environment which may host rich deposits of water ice and other volatiles..

Digital elevation models can be imported directly into UE4 as 16 bit PNG files and used to create a landscape (Fig. 2-3). Although the LOLA gridded products can be used, the result is better when interpolating the LOLA RDR points directly and applying filters for outliers, then smoothing the result.

After the landscape is created, realistic lunar textures, lighting, and assets like rocks/craters can be added to the scene (Fig. 4,6). These can be created from scratch, although it is easier to use pre-made assets from third parties designed specifically for the Moon.

The basic navigation tools in UE4 are sufficient to navigate around the scene, but it is also possible to drop into the map as a playable first- or third person character with realistic lunar gravity.

Currently, UE5 is scheduled for release in late 2021, and will add photorealism to the level of movie CGI.

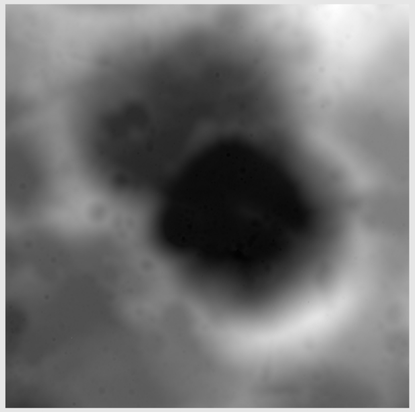

Figure 2. The starting point for the render is a LOLA DEM generated from raw RDR points. Extra processing is done to remove outliers and smooth the terrain.

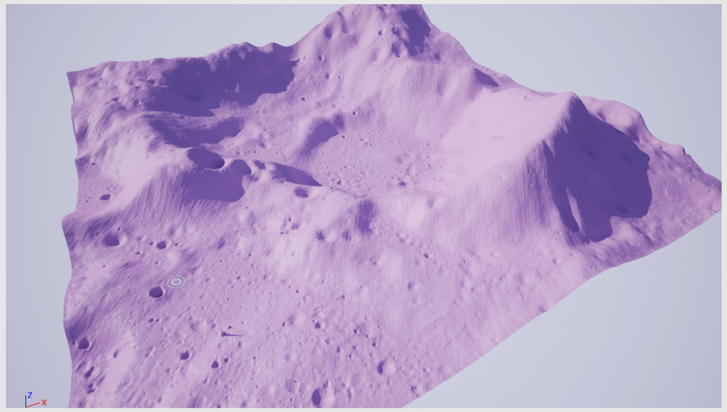

Figure 3. The DEM is imported into UE4 as a landscape with a default texture and lighting conditions. The overall size and therefore scale/resolution can be adjusted, although UE4 has a maximum extent of 20x20 km.

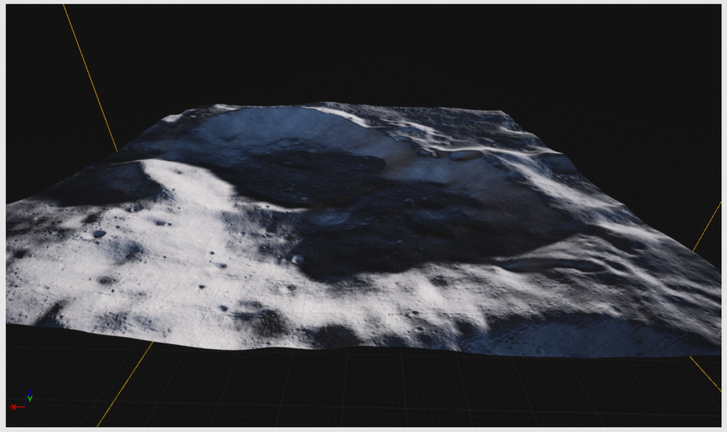

Figure 4. The scene for Sverdrup crater, now adjusted with the proper vertical scaling, a lunar-like texture, and polar illumination with a very low incidence angle. Lighting azimuth and zenith can be easily adjusted in real time.

Figure 5. A third-person player is dropped into the scene, and can be manipulated with keyboard/mouse or a game controller. UE4 also allows for first-person, fly-through, and virtual reality modes, among others.

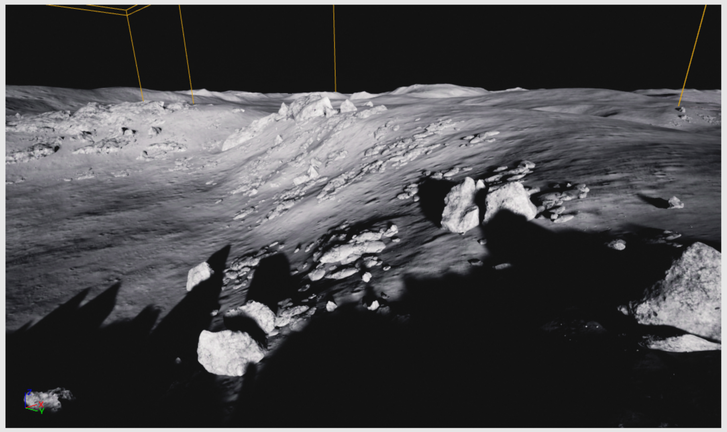

Figure 6. Additional landscape assets including rocks and craters are available from a third-party add on, and can be used to enhance the realism of the scene.

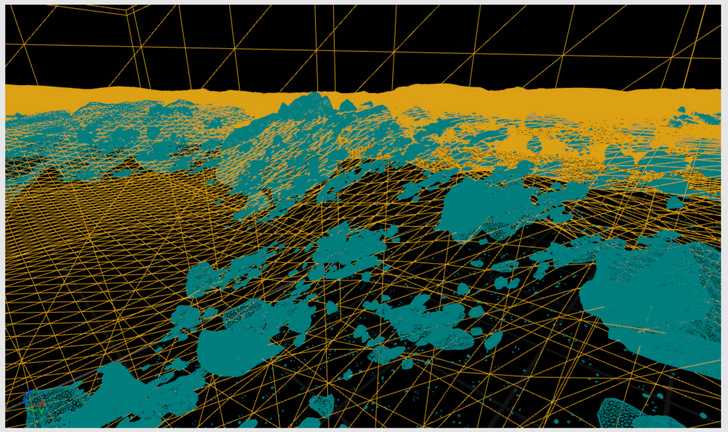

Figure 7. Mesh view of the scene in Fig. 6. Other 3D assets including landers, surface structures, etc. can be imported from common 3D formats including OBJ and STL.