Lunar Rendering Using the GenesisLunar Image Generator

Introduction

There has been an increased interest in space travel in hopes of man returning to the moon and beyond. Simulator training will be used to prepare astronauts for this journey. Simulators will require an Image Generator (IG) to view the moon and stars outside the spacecraft. Diamond Visionic's GenesisLunar IG provides this necessary visualization; rendering a realistic lunar scene directly from source data with no pre-built database required. The eyepoint, or camera, can be located above or on the surface and can be moved and oriented during runtime. Additional moving (and non moving) models can be added to the scene. The ephemeris model is driven by JPL's SPICE toolkit providing accurate positions for celestial bodies at any desired time and date. Shadows can be configured to extend large distances since no atmosphere is present.

Imagery and Elevation Data

Lunar imagery and elevation data are read from disk during runtime to create the accurate lunar scene. **See figure 1**. Note that users can use their own imagery and elevation data. Location accuracy has been verified by independent GIS tools loading the same data.

Albedo Data

GenesisLunar supports the loading of albedo data for solar reflection simulation. Note that users can use their own albedo data.

Figure 1: Lunar surface rendered with GenesisLunar

Feature Data

Features, such as rocks and other static objects are loaded from the disk during runtime as shown in **figure 2.** The features are placed in the scene via Shapefile data.
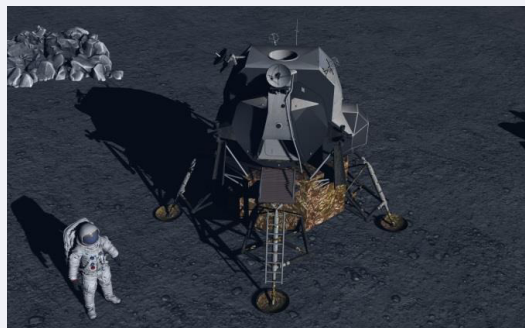
Coordinate System

GenesisLunar is rendered using a round moon model using a moon-centered-moon-fixed coordinate system as shown in **figure 3**. This allows the simulation to be continuous all the way from space to surface.
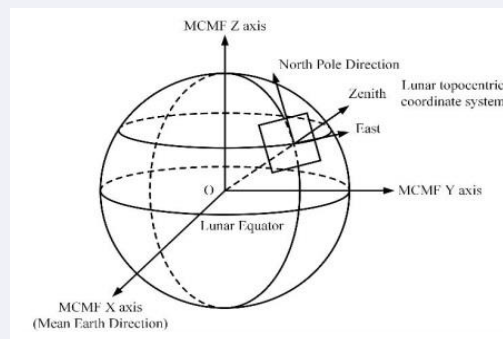

Figure 2: Features rendered in the lunar scene

Figure 3: Moon-centered-moon-fixed coordinate system [1]

Ephemeris Model

GenesisLunar has integrated the JPL SPICE Toolkit which provides accurate positions and rotations for the moon, earth, and sun.

Polar Rendering

GenesisLunar coverate includes the polar regions allowing for any location on the surface can be simulated.

Earthshine

GenesisLunar includes an earthshine lighting effect. An example of earthshine is shown in **figure 4.**

Custom Lighting
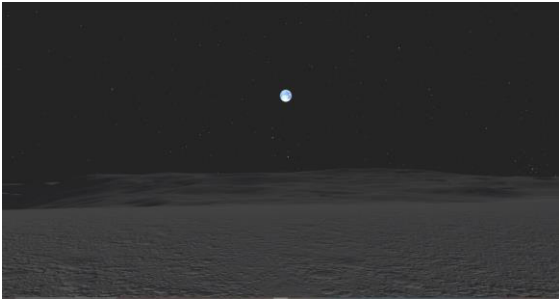
GenesisLunar allows users to implement any desired lighting algorithm to be used while rendering the scene. Per pixel lighting is calculated using a combination of inputs such as imagery, albedo, shadows, surface normals, additional irradiance, sun direction, and ambient lighting. These can be combined to determine final color to display. **See Figure 5.**
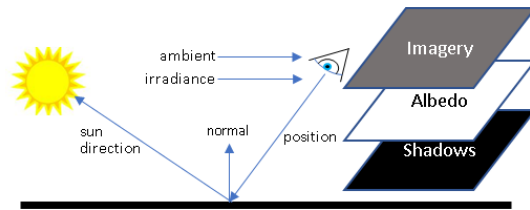
Figure 4: Lighting near the south pole on the moon surface from earthshine.

Figure 5: Inputs to modifiable fragment shader allowing custom lighting algorithms to be implemented.

Data Retrieval for Additional Processing

The GenesisLunar image processing plugin can be used to capture depth and color information on a per pixel basis with custom lighting calculations applied. Results can be used by downstream processes wishing to generate, for example, LIDAR type data from the GenesisLunar rendering.

Additional GenesisLunar Product Information

GenesisLunar comes with a built in Common IG Interface (CIGI) for easy integration with simulation hosts as well as an SDK allowing users to integrate GenesisLunar into their own applications. Future work includes integrating our real-time physics-based sensor solution developed by JRM Technologies in GenesisLunar.
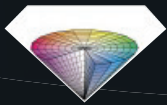
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