Gazebo renders the moon

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RP Driving ConOps Simulator

Resource Prospector

Goal: send a rover to the moon to mine volatiles such as hydrogen, oxygen and water

Simulation

End-to-end lunar rover driving simulation to assist in the development of the RP Driving Concept of Operations

- ROS used to emulate flight software and ground software functionality
- Simulated rover is 4 wheel steer platform scaled to RP rover dimensions with RP chassis and mast
Visual Simulation

Lunar scene from Gazebo

Lunar scene from Apollo 12 mission
Large Scale, High Fidelity Terrain Simulation

Synthetic Terrain Generation
- High resolution (~4cm) to simulate obstacles: positive (rocks), negative (craters)

Large DEMs rendered too slow in Gazebo
- 8K resolution, 213MB
- Load time ~5min

Improvements
- Enabled caching of terrain data
- Added Level-Of-Details
- Background tiles - coarse meshes
  ○ 6 layers
Lunar Appearance

Default shading model - inadequate to model the unique reflective properties of lunar surface

Added support for applying custom shaders to heightmaps
Terrain Material Shader Components

DEM Normal Map

DEM Albedo (diffuse) map

DEM Rock Mask

Pre-Rendered Shadows

Regolith Detail Normal & Rock normal

Real time shadows set up by Gazebo

Hapke Lunar regolith reflectance model
Shader Parameters

Wheel Tracks Plugin

Camera Exposure
Lens Flares

Sun is few degrees above horizon at lunar pole
Camera often points at sun or sees long dark shadows

Implementation
- Post processing effect
- Works with wide angle cameras
- Sparse ray based occlusion checking
Real Time Shadows

**Problem:** Poor quality overall esp. when camera view angle is coincident with light direction

**Improvements**
- Override shadow map generation step
- Increased shadow texture resolution
- Hardware Percentage Closer Filtering + Poisson disk blur filter
- Lowered “built-in ambient” light
Team

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Questions?