The Department of Computer Science and Engineering

University of Nevada, Reno

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Projective Grid Mapping for Planetary Terrain

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science
with a major in Computer Science.

by

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Abstract: Planetary terrain presents a number of issues that terrain rendering techniques commonly fail to address: displaying a vast amount of data at both small and large scales, using datasets in an appropriate map projection for the geographic area depicted, and rendering terrain features that rise from behind the horizon, such as tall mountains. The utility of planetary terrain rendering increases with both the availability of planetary data and the ubiquity of powerful, consumer-level GPUs. In addition, the visualization of full-scale planetary bodies has benefits for education and science. Projective Grid Mapping (PGM) is a GPU terrain rendering technique that combines the advantages of ray casting and rasterization, providing gradual level-of-detail transition and steady framerates. We formulate a version of the projective grid mapping algorithm for planetary terrain; this involves the view-dependent creation of reference spheres for ray casting and the construction of a sampling camera that approximately samples the geographic area of the planet that could possibly affect the final image. In addition, we reduce ray-sphere intersection to two dimensions, which simplifies implementation on the GPU. In order to create a complete planetary terrain renderer, we combine this spherical PGM technique with deferred texturing, which composites overlapping datasets. The visualization operates on the desktop and in two virtual reality displays. We achieve efficient framerates for various grid and screen resolutions, and we demonstrate high-quality views of Mars for both the equatorial and polar regions.

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Scrugham Engineering and Mines (SEM) room 201

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