REAL-TIME VISUALIZATION OF
MASSIVE IMAGERY AND VOLUMETRIC DATASETS

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ABSTRACT

The visualization of extremely large multi-dimensional datasets requires highly scalable geometric algorithms. We consider an algorithm to be scalable if its complexity remains constant independent of the size of the complete dataset. The complexity of the algorithm should only depend upon the visible volume and display resolution.

This thesis develops several algorithms for the display of 2-D and 3-D datasets that achieve scalable performance. We present approaches for visibility culling and level of detail calculation for large datasets in orthogonal and oblique projections. These techniques are extended to support visualizing geophysical data on a sphere with terrain elevation data, as well as volumetric data.

The algorithms presented herein are implemented on top of an existing out-of-core image tile caching and paging system known as Kolam, developed at the University of Missouri, Columbia. Discussions of Kolam's architecture are provided, which include image representations, tile request methods, cache structures, and thread interactions. A detailed user interface description is included as well, covering GUI components, navigation modes, API functions, and a third-party extension framework.