Interactive Out-Of-Core Isosurface Extraction

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Abstract

We present a novel *out-of-core* technique for the interactive computation of isosurfaces from volume data. Our algorithm minimizes the main memory and disk space requirements on a visualization workstation, without compromising the speed of the isosurface extraction queries. Our overall approach is a *two level indexing* scheme. First, by our new *meta-cell* technique, we partition the original data set into clusters of cells, called *meta-cells*. Secondly, we produce *meta-intervals* associated with the meta-cells, and build an indexing data structure on the meta-intervals. We separate the cell information, kept only in meta-cells in disk, from the indexing structure, which is also in disk and only contains pointers to meta cells. Our meta-cells is an I/O-efficient approach for computing a k-d-tree-like partition of the dataset. Our indexing data structure, the *binary-blocked I/O interval tree*, is a new I/O-optimal data structure to perform *stabbing queries* that report from a set of (meta-)intervals those containing a query value q. Our tree is simple to implement, and is also more space-efficient in practice than the existing structures. To perform an isosurface query, we first query the indexing structure, and then use the reported meta-cell pointers to read from disk the *active* meta-cells intersected by the isosurface. The isosurface itself can then be generated from active meta-cells.