A PARALLEL GHOSTING ALGORITHM FOR THE FLEXIBLE DISTRIBUTED MESH DATABASE (FMDB)

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ABSTRACT

The scalable execution of parallel adaptive analyses requires the application of mesh modification operations to modify the partitioned mesh with balanced work load and minimal communication. The thesis presents a parallel algorithm for ghost creation and deletion that localizes neighborhood data for computation to minimize inter-part communication. The ghosting algorithm provides a third-party application with the complete parallel neighborhood information in a partitioned mesh. This reduces the communication pattern in the application to simple point-to-point transfers of numerical information. The thesis presents a ghost creation and deletion algorithm for the Flexible distributed Mesh Database (FMDB) that can create 1D, 2D or 3D ghost objects in a mesh using bridge entities. The algorithm utilizes neighborhood communication to create any number of ghost layers up-to a point where the whole partitioned mesh is ghosted. Ghosting that becomes invalid due to mesh modification can be synchronized by throwing away old ghosts and creating new ones. For testing purposes, a mesh verification algorithm that verifies the validity of the ghosted mesh is also presented.

Strong and weak scaling analysis results of ghost creation and deletion algorithm is presented up-to a core count of 32,768, using two massively parallel architectures i.e. IBM Blue Gene/L and Cray XE6. Performance results show that the scalability of the ghosting algorithm is dependent on the ratio of inter-part communication to computation and the number of ghost entities that keep on increasing with increasing processor count.