PARALLEL GUARANTEED QUALITY DELAUNAY MESH GENERATION AND REFINEMENT: CURRENT STATUS

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Abstract: Unstructured adaptive mesh generation and refinement (UAMR) methods have matured over the past 15 years and are now the method of choice for many multiscale applications. UAMR poses a number of difficult technical challenges, both in terms of the algorithms involved and the software complexity. In the recent years some of the research effort has been directed at issues like mesh quality and parallel mesh generation. This paper describes the current status and future directions for parallel guaranteed quality Delaunay based UAMR methods.

Parallel mesh generation methods decompose the original meshing problem into smaller subproblems that can be solved (i.e., meshed) in parallel. The requirements for the solution of the subproblems on parallel and distributed memory computers are: (1) *stability*, distributed meshes should retain the good quality of elements and partition properties of the sequentially generated and partitioned meshes, (2) *tolerance of long, variable, and unpredictable latencies*, (3) *scalability* (4) *fault-tolerance*, and (5) *code re-use*, in order to leverage the ever evolving basic sequential meshing techniques.

The design and implementation of well tested and fine tuned UAMR codes is a very expensive and time consuming task. The same task becomes orders of magnitude more complex in the case of *scalable, stable, and guaranteed-quality parallel mesh generation*. In order to develop cost-effective, scalable and stable guaranteed-quality parallel mesh generation methods we are experimenting with three different approaches: (1) parallelization of existing sequential guaranteed quality Delaunay methods, (2) parallel Constrained Delaunay meshing methods, and (3) parallel Domain Decoupling methods. In the rest of this paper I will present a short overview on the current state-of-the-art parallel methods for mesh generation and then I will briefly describe the three approaches we developed at the College of William and Mary in collaboration with Cornell University.

Key Words: Parallel Delauany Mesh Generation, Refinement, Quality.

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