the original algorithm. Not only is mesh quality affected by this change, but neither the correctness of the resulting mesh, nor the termination of the algorithm, can be proved. These problems exemplify the need for the creation of a wholly new parallel algorithm for Delaunay mesh generation.

While the parallelization of an existing algorithm seems appropriate at first glance, our experience shows that there is a need for the creation of purely parallel algorithm. This new algorithm will be developed keeping in mind the errors, the inconsistencies, and the inefficiencies that arise due to concurrency. The complexity and the performance of our current parallel implementation clearly demonstrate the need for such an algorithm. Our results also show that parallel Delaunay meshing based on the B-W kernel is a foreseeable goal, although much work remains to be done to realize an efficient guaranteed - quality parallel mesh generator.

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DYNAMIC BUBBLE SYSTEM: AN AUTOMATIC MESH GENERATION SYSTEM FOR 2D AND 3D FINITE ELEMENT MESH GENERATION IN ELECTROMAGNETIC FIELD COMPUTATIONS

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ABSTRACT

A large number of methods and techniques for automatic mesh generation have already been proposed, among which the ideas based on the so called Voronoidiagram and the Delaunay algorithm seem best suited for finite element mesh generation [1]. However, for the Delaunay tessellation algorithm to be employed, one must have a set of nodes which are optimally distributed inside the analysis domain.

The authors recently developed a new method for automatic mesh generation in 2D and 3D space based on dynamics of the bubbles according to the Second Newton's Law of Dynamics [2]. The proposed method features setting a small number of initial data for meshing at several typical points inside the domain, such as vertices that bounds the entire domain. Later, using simple functions, we compute centers and radii of each bubble. After filling the entire analysis domain with bubbles which are defined three parameters: coordinates of a center, mass and radius, a set of dynamic forces will act on each bubble causing bubbles to move inside the analysis domain. These movements are performed until the stable condition for the entire dynamic system of bubbles is achieved. Afterwards, each center of an existing bubble becomes one vertex of the finite element mesh which is generated utilizing the Delaunay tessellation algorithm over this set of vertices.

The main features of the proposed dynamic bubble mesh generation system are:

- Easy applicable for meshing complex geometrical domains;
- Requires very small amount of input data for meshing;
- Generates meshes with graded mesh density control, which is easily regulated with setting a small initial bubble radius around nodes where dense mesh is required, and opposite, setting a large initial bubble radius at a node results in coarse mesh density around that node;
- Provides easy regulation of the nodes distribution according to the user defined functions. Since we use this method in connection with electromagnetic field computations where the field potential drops exponentially, using exponential functions enables almost optimal distributions of nodes and elements for a given problem. For different problems, different node distribution functions can be used;
- provides finite elements with very good quality - almost equilateral triangles or tetrahedrons;
- easy extendable for adaptive mesh generations.

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