AUTOMATIC DOMAIN DECOMPOSITION FOR PARALLEL 2D CONSTRAINED DELAUNAY MESH GENERATION

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One of the main requirements for parallel mesh generation is stability i.e., distributed meshes should retain the high quality of elements generated by sequential Delaunay mesh generation methods. In [1] we presented a Parallel Constrained Delaunay Mesh (PCDM) generation method, but the domain decomposition was not automatic for all types of domains. In some cases we had to even manually correct the decomposition in order to avoid the creation of small features which influence the stability, efficiency and in some cases even the termination of the algorithm. In this paper we present an automatic domain decomposition method which generates decompositions whose interfaces do not create any new features like segments and angles which are smaller than given bounds.

The decomposition method we use is based on the Medial Axis Transformation (MAT). MAT is the locus of the centers of the maximal spheres inscribed in the domain. MAT has been proposed by Blum [2] to describe biological shapes and it has been used in sequential finite element mesh generation [3, 4, 5]. The construction of the MAT is based on the path tracing approach [6]. Our choice is based on the following reasons: (1) the possibility to derive the parametric representation of the MAT, which is useful for the discretization of the MAT, (2) the generalization to 3D, and (3) the easier implementation of the method.

The MAT may contain degenerate elements like arbitrarily small segments and angles, which need to be detected and eliminated, because they create arbitrary small features which in turn affect the stability of the parallel mesh. For this purpose, we use a variation of the technique described in [3, 4], which employs the merging of MAT branches and points. In [3, 4] the mesh is then constructed by first generating nodes along boundaries of subdomains and then connecting them and smoothing the mesh if necessary. In PCDM approach, the points are inserted in parallel into each of the subdomains until the desired quality and size requirements are met. The consistency of the submeshes is ensured by splitting the boundary edges on both neighboring processors.

References

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