Parallel Delaunay tetrahedrization of a given discrete point set constrained by an imposed boundary mesh

Pablo J. Novara[1,2], Nestor A. Calvo[1,2]

[1] Facultad de Ingeniería y Ciencias Hídricas, Universidad Nacional del Litoral (FICH-UNL)
[2] Centro de Investigación de Métodos Computacionales (CIMEC-CONICET)
{pnovara,ncalvo}@unl.edu.ar

ABSTRACT

This article presents a parallel method for generating a valid finite elements all-tetrahedral 3D mesh, starting from an imposed boundary mesh and a fixed set of points, following the Delaunay criteria whenever possible. The proposed meshing algorithm connects the points inside the volume described by the boundary mesh, building and all-tetrahedral mesh without adding, removing, nor moving input points, and fitting that imposed boundary. This is a very common scenery in particle methods such as PFEM2[1]. The approach combines DeWall[2] algorithm with some techniques inspired in advancing front methods. It can be parallelized, for both shared and distributed memory models. This paper focuses on efficiently solving problems related to boundary meshes that make it impossible to enforce the Delaunay condition, and discusses many implementation details that arise when dealing with threads synchronization, numerical errors, and ambiguous Delaunay configurations, in order to provide a detailed and reproducible algorithm. Results from a shared memory implementation are also presented here, discussing the actual data structures and the required tweaks in order to obtain competitive times, showing a very good stability, scalability, and parallel efficiency.

REFERENCES

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