

Hexahedral Overlay Grid Method with Guaranteed Element Quality

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ABSTRACT

Hexahedral mesh generation using overlay grid methods has the benefit of being fully automatic, requiring minimal user input. These methods utilize a mesh-first approach to mesh generation where an initial mesh, usually a grid, is used to overlay the reference geometry. Procedures to modify the initial mesh are employed to best capture the geometry to define a conformal all-hex mesh [1].

One of the main drawbacks of these methods is the resulting mesh quality. While the interior of the mesh remains the same as the initial mesh, the elements located at the interfaces between materials are those that are the most affected and can end up quite deformed or even inverted. The main purpose of the presented work is to avoid such issues so as to ensure a minimal quality of elements.

Our method draws upon the overlay grid pipeline described in [2] where several steps will be adapted so that the resulting mesh has only positive minimum scaled jacobian elements; in particular the projection, the pillowing and the smoothing steps where the geometry and the topology of the mesh are modified are adapted. Additionally, the cell material association is also impacted so as to avoid configurations where no good node positioning is possible.

Several examples will be exhibited both in 2D and 3D illustrating the validity of our approach, with examples of various types, such as CAD models, STL and data from CFD simulations.

REFERENCES

- [1] Schneiders, R. A Grid-Based Algorithm for the Generation of Hexahedral Element Meshes. *Engineering with Computers*, 12(3), pp. 168–177, 1996.
- [2] Owen, S.J., Staten, M.L. and Sorensen, M.C. Parallel hex meshing from volume fractions. *Proceedings of the 20th International Meshing Roundtable*, pp. 161–178, 2011.