Scalable Octree-Based Mesh Generation For Finite Element Computations

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ABSTRACT

The development of powerful computational resources and scalable parallel finite element solvers has created unprecedented new opportunities for scientists and engineers to solve a range of complex, physical phenomena at larger scales and resolution than heretofore possible. Here, high-resolution means meshes containing billions of elements. However, build such discretizations efficiently is not an easy task. Octree-based mesh generation methods have achieved high levels of scalability (more than 2000 cores) resulting in reasonable-quality elements [1][2]. In this work, we presented a scalable octree-based conforming mesh generation and measure the performance impact in transforming non-conforming meshes, generated by the octree method, to conforming meshes. First, conforming techniques for meshes generated from octree are reviewed. Then a conforming technique based on templates is implemented in a meshing algorithm, which uses a linear octree with 2:1 balancing constraint from immersed geometries. Besides, a change on the partitioning strategy for the same meshing algorithm is proposed to improve the octree refinement load balancing. Element quality measures show the quality of resulting meshes. Scalability analysis shows the low impact of the chosen conforming techniques on meshing performance and gains on execution time resulting from the change on the octree refinement partitioning.

REFERENCES

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