High-Order, Curvilinear Tetrahedral Mesh Generation via a Log-Barrier Deformation Approach
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ABSTRACT

High-order methods have become popular for use in computational mechanics simulations requiring high accuracy. For example, high-order partial differential equation methods have been used in the computational fluid dynamics community in order to resolve the flow dynamics to high accuracy. Such methods typically require the use of a high-order mesh.

In this talk, we will present our method for generation of high-order, curvilinear tetrahedral meshes, namely LBWARP2Gen. The method deforms a low-order tetrahedral mesh into a high-order tetrahedral mesh based on a log barrier approach. The high-order tetrahedral mesh is generated according to the following three-step process. First, the initial linear tetrahedral mesh if modified by inserting nodes at the midpoint of each line segment. Second, the midpoints on the boundary are displaced onto the prescribed boundary. An interior point method for nonlinear programming is used for the projection step. Third, the final positions of the interior nodes are identified based on the boundary deformation. A projected Newton method is used to determine the weights which represent each interior node as a convex combination of its neighbors; the weights are then used to determine the final positions of the interior nodes in the high-order mesh. We will present the results of deforming several linear tetrahedral meshes into high-order, curvilinear tetrahedral meshes.

This research extends the previous work of Stees and Shontz on high-order triangular mesh generation [1].

REFERENCES

[1] M. Stees and S.M. Shontz, "A quadratic high-order method for mesh generation inspired by LBWARP", Research Note of the 25th International Meshing Roundtable. (2016)