Simulation-Driven Adaptivity of High-Order Meshes

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ABSTRACT

We present a framework for adaptive optimization of high-order curved meshes. The optimization process is driven by information that is provided by the simulation in which the optimized mesh is being used. We make the important choice to require only discrete description of the simulation feature to which to adapt to, e.g., the feature can be described as a finite element function on the mesh. This is a critical step for the practical applicability of the algorithms we propose and distinguishes us from approaches that require analytical information.

This work builds on the results of [1], where we describe a framework for controlling and improving the quality of high-order finite element meshes based on extensions of the Target-Matrix Optimization Paradigm (TMOP) of [2]. In contrast to [1], where all targets are based strictly on geometric information, the construction of target-matrices is enhanced by using discrete fields of interest, e.g., shock positions, material regions, and known error estimates. As these discrete fields are defined only with respect to an initial mesh (which must be optimized), their values on the intermediate meshes (produced during the optimization process) must be computed.

The benefits of the presented methods are illustrated on examples from the high-order arbitrary Lagrangian-Eulerian (ALE) application BLAST [3]. BLAST utilizes moving curved meshes to perform multi-material simulations of compressible shock hydrodynamics and radiation diffusion.

REFERENCES

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