Adaptive spacetime finite element methods for multi-scale simulations in computational science and engineering

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ABSTRACT

Spacetime discontinuous Galerkin (SDG) finite element methods are a new class of solution schemes, suitable for many multi-scale and multi-physics problems in computational science and engineering. For many problems of interest, their per-element balance properties, powerful local adaptive operations, linear computational complexity and naturally scalable parallel structure enables them to dramatically out-perform previous analysis methods. This talk introduces the basic concepts of SDG methods and highlights their applications to structural dynamics, contact mechanics, dynamic fracture, hyperbolic conduction and compressible gas dynamics. We briefly describe current research in which we extend our previous results in two spatial dimensions to models cast in 3d x time and explore new asynchronous load-balancing schemes to support parallel computation in the context of extreme dynamic, adaptive model enrichment and coarsening.

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