AN h–ADAPTIVE SPACETIME DISCONTINUOUS GALERKIN METHOD FOR ELASTODYNAMICS

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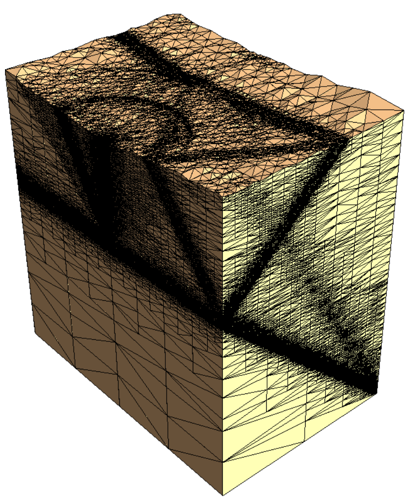
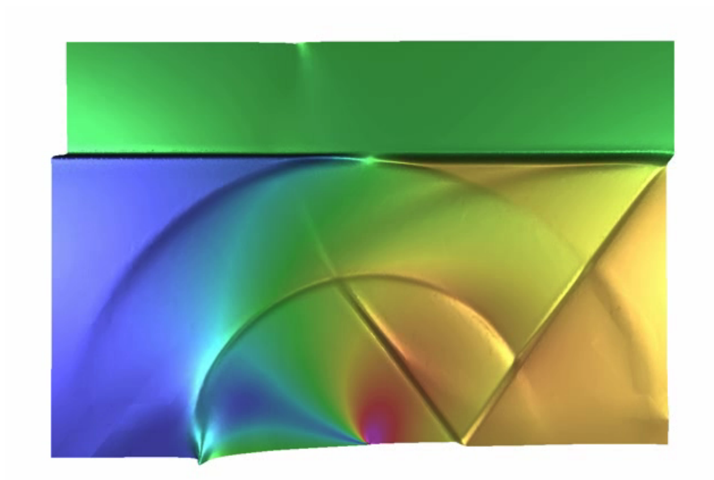
We present an h–adaptive implementation in 2D×time of a spacetime discontinuous Galerkin (SDG) method for linearized elastodynamics [1]. The SDG formulation features a Bubnov–Galerkin projection that is stable and free of spurious oscillations for polynomial order $p \geq 2$, exact balance of linear and angular momenta over every spacetime element, and linear computational complexity in the number of elements. We examine the impact of enforcing Godunov values (vs. averaged values) for the jump conditions on *noncausal* element faces, and study the convergence rates for dissipation and an *a priori* error estimate.

We use an extended version of the Tent Pitcher algorithm [2] to generate adaptive, patch–wise causal spacetime grids. The SDG basis functions, which naturally accommodate nonconforming grids, facilitate refinement and coarsening. Our use of unstructured spacetime grids allows for simultaneous grading in space and time, providing extra efficiency in shock–capturing applications, as shown in the figures. The mesh generation and finite element solution processes are interleaved on a patch–by–patch basis, so decisions to refine or coarsen the grid can be made locally. We present examples that demonstrate the method's ability to capture accurately complex shock patterns using a dissipation–based error indicator.



a) Adapted spacetime mesh; refinement ratio = 1024



b) Snapshot of crack–tip shock scattering

References

[1] R. Abedi, B. Petracovici, R. Haber, A spacetime discontinuous Galerkin method for linearized elastodynamics with elementwise momentum balance, *Comp. Methods Appl. Mechs. Engrng.* In press.

[2] R. Abedi, S. Chung, J. Erickson, Y. Fan, M. Garland, D. Guoy, R. Haber, J. Sullivan, S. Thite, Y. Zhou. Spacetime meshing with adaptive refinement and coarsening. In *Proc. Symp. Comput. Geom.*, p 300–309, 2004.

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