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A SUBCELL METHOD FOR STABLE MESH MOTION WITH LAGRANGIAN HYDRODYNAMIC METHODS ON QUADRATIC ELEMENTS

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Quadratic elements have edges that can bend and are essential for achieving higher-order convergence and they can enable greater mesh deformation in Lagrangian hydrodynamic calculations. The challenge is that quadratic elements can bend and deform in unphysical ways. One approach for more stable mesh motion is to filter the Riemann velocities to reduce spurious mesh motion [1]. The velocity filter approach [1] is an iterative approach that produces stable mesh motion on complex vortical flows with quadratic elements. In this work, we present a new method to ensure stable mesh motion using subcell densities. The new method evolves the velocity at an interior node and calculates the density at subcell locations using an evolution equation. Near shocks, the subcell density is used to calculate the pressure that is used in the Riemann solver at the exterior element nodes. The new method is used with a Lagrangian DG hydrodynamic method by Liu et al. [2] to simulate two-dimensional gas dynamic problems on unstructured quadratic elements. Test problem results, including the polar Sod problem (Fig. 1), will be presented to demonstrate the robustness and convergence order of the method.

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REFERENCES

[1] N. Morgan, X. Liu, and D. Burton. Reducing spurious mesh motion in Lagrangian finite volume and discontinuous Galerkin hydrodynamic methods. *Journal of Computational Physics, in review.*

[2] X. Liu, N. Morgan, and D. Burton. A Lagrangian discontinuous Galerkin method. *Journal of Computers and Fluids, https://doi.org/10.1016/j.compfluid.2017.12.007.*

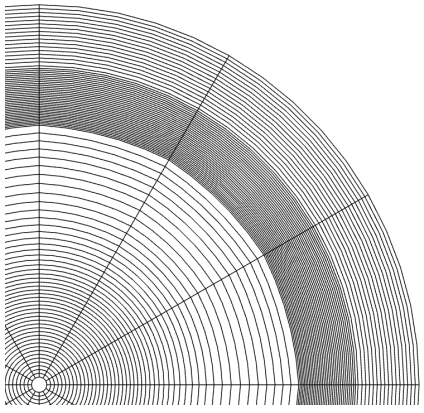

Figure 1: A polar Sod calculation