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A COMPATIBLE LAGRANGIAN DISCONTINUOUS GALERKIN HYDRODYNAMIC METHOD FOR 2D AND 3D GAS DYNAMICS

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The modal Lagrangian discontinuous Galerkin (DG) method [1, 2, 3] evolves piecewise polynomial expansions forward in time for specific volume, velocity, and specific total energy. In this work, a specific kinetic energy polynomial expansion is derived and used to calculate a compatible specific internal energy distribution in the element that guarantees the conservation of the total energy. A merit of the compatible formulation is that the specific internal energy can be limited to enforce positivity and boundedness. The pressure is a nodal quantity and calculated at quadrature points and at the element corners using the equation of state and the bounded specific internal energy and specific volume. Discontinuities in the velocity and pressure at the element surface are resolved by solving a multidirectional approximate Riemann problem at the nodes. The details on the new Lagrangian DG method will be presented. Both 2D and 3D test problem results, including the 3D Sedov problem (Fig. 1), will be presented to demonstrate the robustness and convergence order of the new method.

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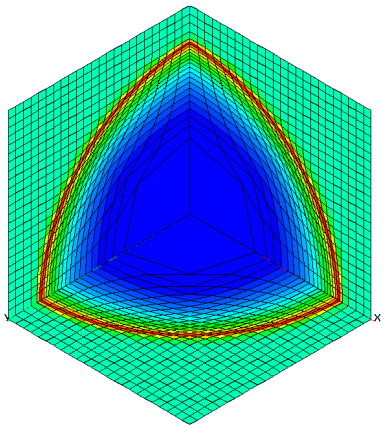

Figure 1: A 3D Sedov calculation