6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 15 June 2018, Glasgow, UK

A HIGHER-ORDER LAGRANGIAN DISCONTINUOUS GALERKIN HYDRODYNAMIC METHOD FOR ELASTIC-PLASTIC FLOWS

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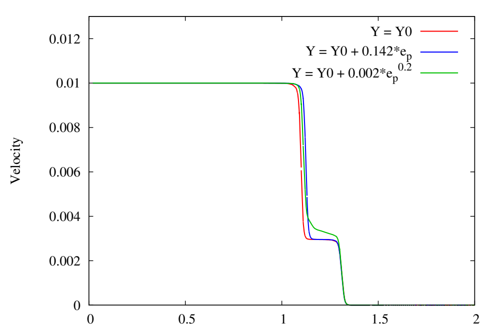
Key words: *Computational hydrodynamics, Multi-material flows, Lagrangian, Hypoelasticity*

We present a new high-order Lagrangian discontinuous Galerkin (DG) hydrodynamic method for gas and solid dynamics. The evolution equations for specific volume, momentum, and total energy are discretized using the modal DG approach. The specific volume, velocity, and specific total energy fields are approximated with up to quadratic Taylor series polynomials. The specific internal energy, pressure, and stress deviators are nodal quantities. The stress deviators are evolved forward in time using a hypoelastic plastic approach, which requires a velocity gradient. A new method is presented for calculating a high-order polynomial for the velocity gradient in an element. The plasticity is handled by applying a radial return model to the stress deviators. Plastic hardening is represented by either a linear or power-law hardening model as a function of overall plastic strain. Limiting approaches are presented for modal and nodal fields. The TVD RK time integration method is used to temporally advance all governing evolution equations. Generalized Lagrangian DG equations are derived but test problems are calculated for 1D Cartesian coordinates. A suite of gas and solid dynamics test problems are calculated to demonstrate the stability and formal accuracy of the new Lagrangian DG method.



The calculated velocity field in an elastic-plastic piston problem with aluminum using the DG method with quadratic polynomials and different hardening models.

REFERENCES

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