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AN EDGE BASED VERTEX CENTRED UPWIND FINITE VOLUME METHOD FOR LAGRANGIAN SOLID DYNAMICS

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Recently, a new mixed formulation has been proposed by the authors in fast solid dynamics [1]. The mixed formulation is comprised of conservation equations for the linear momentum, the deformation gradient and the total energy of the system. The formulation has been implemented using 2D linear triangular elements and 3D linear tetrahedral elements with a variety of numerical schemes [1, 2, 3, 4]. The methodology has been shown to be robust, yielding equal order of convergence in velocities and strains and with excellent behaviour in bending dominated scenarios.

This paper presents an alternative implementation using an edge-based Finite Volume solver with linear reconstruction and flux limiters. This results in an efficient algorithm that combines the accuracy of the upwind cell centred scheme [1] with the computational efficiency of an edge-based solver as the one presented in reference [4]. An additional conservation law for the Jacobian of the deformation is solved which enables the modeling of nearly incompressible materials and the simulation of Lagrangian shock hydrodynamics. A series of benchmark problems are presented to demonstrate the capabilities of the new algorithm for a wide range of scenarios: hyperelastic, elasto-plastic and thermo-mechanical solids.

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