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A Multi-material Eulerian Formulations and Hydrocode For the Simulation of Explosions

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There are many explosion phenomena in engineering practice, such as explosion machining, shaped charge jets in oil well perforators in the oil industry, evaluation of explosion accidents in buildings or underground tunnels. Besides theoretical and experimental approaches, numerical simulations begin to play an important role in studying these phenomena with the rapid progress in computer software and numerical methods.

A multi-material Eulerian hydrodynamic numerical method and hydrocode that can effectively simulate explosion problems in engineering practice has been developed in this study. A modified Youngs' interface reconstruction algorithm is proposed for mixed cells, in which the material's volume fractions of the surrounding cells are not only used to reconstruct the material interface but also adopted to determine the transport order of the material. The algorithm developed herein is validated by the modeling of several tests, such as objects with different shapes moving in translational, rotating and shear flow field in two dimensional Descartes coordinates and axis-symmetric cylindrical coordinates. Results show that convergence is indeed obtained. Moreover, the explosion problem in the tunnel with an expansion-chamber and the jet formation of shaped charge are numerically simulated, and the numerical results show good agreement with the observed experimental data.

References

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