IMPLICIT DISCRETIZATION OF LAGRANGIAN GAS DYNAMICS

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ABSTRACT. We have recently proposed an implicit discretization of the Lagrangian gas dynamics in 1D in [1]. Whichever the time step $\Delta t > 0$ is, we proved that the scheme is well defined, conservative and stable. More precisely, the scheme ensures that the solution obtained at time t^{n+1} belongs to the invariant domain of Euler's equation and that it satisfies the desired entropy inequality.

In short, the method proposed and analyzed in [1] is a predictor-corrector scheme. Following [2], the implicit predictor step approximates isentropic Euler equations, and the corrector explicit step restores the conservation of total energy using the implicit fluxes computed in the predictor.

In this presentation, we show how this method extends to higher-dimension and explain the new difficulties in this case. We insist on the discrepancy of the volumes calculation computed by the scheme and using the new node positions. We explain how to modify the scheme to retrieve the same stability properties as in the 1D case. The behavior of the scheme is illustrated using representative numerical tests.

Keywords: Lagrangian, Finite volume, gas dynamics, implicit method, nonlinear stability.

Mathematics Subject Classifications (2010): 65M08, 65M22.

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