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von Neumann Stability Analysis of Pressure-Based Formulation of 1D and 2D Euler Equations SANTOSH KONANGI, URMILA GHIA, University of Cincinnati — The stability properties of a pressure-based scheme for the Euler equations are investigated, as such schemes are widely employed in commercial computational fluid dynamics codes. The published literature often focusses on model equations, and does not consider the solution scheme used in the parent code. The present study conducts a von Neumann stability analysis for a pressure-based, segregated scheme, SIMPLE (Semi-Implicit Method for Pressure-Linked Equations). The 1D and 2D Euler equations, closed by an "artificial" equation of state, are discretized using finite differences on a staggered grid, which permits equivalence to finite-volume discretization. As a first effort, first-order accurate spatial and temporal schemes are analyzed, to determine error amplification matrices, identify stable and unstable regimes, and predict practical stability limits in terms of the maximum allowable CFL number as a function of Mach number. The predictions are verified using the Riemann problem at several Mach numbers, and very good agreement is obtained between the predicted and the "numerically" observed CFL values. Hence, the present results should prove useful in guiding the stability of a simulation using the parent-code and the scheme tested here.

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