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A CONSERVATIVE IMPLICIT MULTIRATE METHOD FOR HYPERBOLIC PROBLEMS

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Conservation laws model a large variety of phenomena in geophysical flows, typical examples are shallow water flow, multiphase groundwater flow, advection and dispersion of contaminants, etc. The time discretization of hyperbolic problems is often subject to restriction of the time step. Explicit time integration schemes are only stable if the time step amplitude fulfills the CFL condition. It is also possible to use an implicit, method but all high order implicit scheme are not unconditionally monotone, a different condition for the size of time step is required to ensure monotonicity. To overcome this problem, we focus on a self adjusting multirate strategy based on an implicit method that could benefit from different time steps in different areas of the spatial domain. We propose a novel formulation of a mass conservative multirate approach, that can be generalized to various implicit time discretization methods. It is based on a flux partitioning, so that flux exchanges between a cell and its neighbors are balanced. The self adjusting multirate time stepping strategy has been proposed for the first time by [5], we base our work on an extended version proposed in [1]. Constantinescu et al. in [3] and Fok in [4], introduce a multirate Runge-Kutta method that conserve the stability properties of the single-rate approach using an explicit solver to integrate in time the system. A number of numerical experiments on both non-linear scalar problems and systems of equations have been carried out to test the efficiency and accuracy of the proposed approach [2].

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