

Assessment of multigrid preconditioners for solving systems induced by ImEx methods

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Abstract

Implicit time integration schemes are essential for simulating different phenomena when large time steps are required. This is for example the case when dealing with low Froude number flows are addressed, and if one interested in convective phenomena only. However, their efficiency depends on the effective resolution of a linear systems. In this work, we develop and analyze a multigrid preconditioning strategy for the implicit discretization of one-dimensional wave equation. The approach is based on nested one-dimensional meshes and employs a damped Jacobi-based multigrid smoother, and an adaptive residual-based strategy is introduced to improve convergence. The effectiveness of the method is evaluated both numerically and theoretically in the context of the wave system, where the preconditioner significantly accelerates the convergence of the iterative solver. Additionally, we discuss the potential extension of this method to Implicit-Explicit formulation for shallow-water equations.

Joint work with

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