

On stage-parallel preconditioning of implicit Runge-Kutta methods

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Fully implicit Runge–Kutta methods offer the possibility to use a high order accurate time discretization with desirable stability properties. For general implicit Runge–Kutta methods all stages are coupled, leading to a potentially costly and involved solution procedure which has been a major barrier to their widespread use.

We present a stage-parallel block preconditioner for the class of strongly A-stable Radau IIA Runge–Kutta methods. We discuss how to approach the analysis of the preconditioned matrices which are non-symmetric and in tensor form. We illustrate the parallel performance by numerical examples, comparing space-parallel but serial in stages against fully stage-parallel implementations on HPC platforms.

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