Local Fourier Analysis of Block-Structured Multigrid Relaxation Schemes for the Stokes Equations

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Multigrid methods that use block-structured relaxation schemes have been successfully applied to several saddle-point problems, including those that arise from the discretization of the Stokes equations. In this talk, we present a local Fourier analysis (LFA) of block-structured relaxation schemes for the staggered finite-difference discretization of the Stokes equations to analyze their convergence behavior. Three block-structured relaxation schemes are considered: distributive relaxation, Braess-Sarazin relaxation, and Uzawa relaxation. In each case, we consider variants based on weighted Jacobi relaxation, as is most suitable for parallel implementation on modern architectures. From this analysis, optimal parameters are proposed, and we compare the efficiency of the presented algorithms with these parameters. The theory shows best performance from inexact Braess-Sarazin and distributive weighted Jacobi, with both outperforming Uzawa relaxation. Finally, some numerical experiments are presented to validate the two-grid and multigrid convergence factors.

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