An error-based low-rank correction for pressure Schur complement preconditioners

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We describe a multiplicative low-rank correction scheme for pressure Schur complement preconditioners to accelerate the iterative solution of the linearized Navier-Stokes equations. The application of interest is a model for bouancy-driven fluid flows described by the Boussinesq approximation which combines the Navier-Stokes equations enhanced with a Coriolis term and a temperature advection-diffusion equation. The update method is based on a (best) low-rank approximation to the error between the identity and the preconditioned Schur complement. Numerical results on a cube and a shell geometry illustrate the action of the low-rank correction on spectra of preconditioned Schur complements using known preconditioning techniques, the BFBt method and the SIMPLE method. Computational costs of the update method are also investigated. The goal is to identify settings in which such update methods can lead to accelerated solvers.

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