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A Block Preconditioner Based on Sparse Approximate Commutators

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We consider the F_p preconditioners proposed by Kay & Loghin and Silvester, Elman, Kay & Wathen for the linear systems associated with solving the incompressible Navier-Stokes equations. These F_p methods require the construction of a convection-diffusion operator projected onto the pressure space (denoted F_p). Numerous theoretical and numerical studies have demonstrated mesh independent convergence and the overall efficacy of the approach.

In this talk, we address a potential drawback of the F_p preconditioners: the required construction of F_p by the application. While most incompressible flow codes have the primary kernels needed for building F_p, its actual construction can still pose a significant burden to many large scale parallel simulation codes. As an alternative, we consider automatic ways of computing F_p based on sparse approximate inverses and the notion that operators in the Schur complement often nearly commute. An algorithm (SPAC) is given for constructing F_p automatically and numerical comparisons are performed to demonstrate that favorable convergence properties are retained.