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Block preconditioners based on consistent splitting of incompressible flow equations

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Many existing computational methods for solving the incompressible Navier–Stokes equations depend on the availability of strategies for approximating the associated pressure equation which is a consequence of the incompressibility constraint. Examples of methods that require such approximations are segregated solution strategies where velocity and pressure updates are obtained separately, and preconditioned Krylov subspace methods with preconditioners derived from the Schur complement reduction. Recently, consistent ways to approximate the pressure have emerged. We consider the derivation of such splitting schemes and show how these ideas can be utilized to develop block preconditioners that have solid foundations on the underlying partial differential equation model of fluid flow.