An Exact Projection Method

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Abstract: Projection methods for solving the incompressible Navier-Stokes or Stokes equations typically have temporal splitting errors associated with them when the convective or diffusive terms are solved implicitly or semi-implicitly. An exact projection method is described which has no splitting error and which guarantees the incompressibility condition is satisfied to machine precision. This projection has the added benefit of reducing the number of solution unknowns. The projection is demonstrated using an unstructured staggered mesh spatial discretization scheme, on 2D cavity flow and on a multiply connected free-surface flow with a moving mesh. Analysis and numerical results indicate that the method requires roughly half the CPU time of classic projection methods.