TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

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A New Pressure Poisson Approach for the Incompressible Navier-Stokes Equations

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Abstract.

Common efficient schemes for the incompressible Navier-Stokes equations, such as the projection or fractional-step methods, may introduce numerical boundary layers or have difficulty achieving high order temporal discretizations. In this talk, we take an alternative approach and recast the Navier-Stokes equations as an equivalent pressure-Poisson system. Upon discretization, the resulting numerical scheme exactly preserves the velocity divergence constraint, and hence no conventional projection step is required. Such a situation occurs even in the practical case of a semi-implicit discretization where the pressure and nonlinear terms are treated explicitly, while the viscosity term is treated implicitly. In practice, the implementation details closely parallel that of the projection method, with the primary difference being the implementation of boundary conditions. In this talk, we will discuss the stability of the scheme, and illustrate the approach with some numerical examples.