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# Eliminating the Pressure-Velocity Coupling from the Incompressible Navier-Stokes Equations Using Integral Transforms

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The present work develops a numerical method for solving the unsteady incompressible Navier-Stokes equations with primitive variables in three dimensions. It uses integral transforms to obtain an analytical and continuous solution for pressure from the Poisson equation, whose source term is still obtained from discrete velocity data. Pressure gradients in the incompressible Navier-Stokes equations are then replaced by this analytical expression relating them to the discrete velocity field. The resulting fully parabolic system of equations for the discrete velocity field is simulated using standard finite-differences schemes. Error and order analysis are presented to verify the accuracy of the present methodology and computational time comparisons with well known projection methods are discussed to analyze its efficiency.

**Keywords:** Classical integral transforms, Poisson equation, Finite differences, Incompressible Navier-Stokes equations, Projection methods.