A Class of Truly Consistent Splitting Schemes for Incompressible Flows

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Abstract: A new class of splitting schemes for incompressible flows is introduced in this paper. The new schemes are based on a weak form of the pressure Poisson equation, and at each time step, only require to solve a vector Poisson-type equation for the velocity and a Poisson equation (in the weak form) for the pressure, just as the pressure-correction and velocity-correction schemes. However, unlike in a pressure-correction or velocity-correction scheme, the pressure approximation suffers from a splitting error which results in a loss of accuracy for the vorticity and the pressure, the first- and second-order consistent versions of the new splitting schemes are free of splitting errors and deliver full accuracy for the vorticity and the pressure.