

IMPLICIT-EXPLICIT (IMEX) METHODS FOR THE INCOMPRESSIBLE, VARIABLE-VISCOSITY NAVIER-STOKES EQUATIONS

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ABSTRACT. In implicit-explicit (IMEX) temporal discretisations of the Navier–Stokes equations, the viscous term is kept implicit, while convection is treated either explicitly or semi-implicitly. Such methods are very popular, as they simplify implementation, improve computational efficiency and retain good numerical stability. For flows with non-constant viscosity, as arising in various practical applications, it can be attractive to treat also the viscous term in a semi-implicit manner. That allows us, for instance, to use simpler solvers by avoiding additional terms that would otherwise couple the velocity components. In this talk, we consider different IMEX treatments of the viscous term and discuss the implications of such approaches. This includes deriving, for first-order schemes in time, stability estimates that do not incur CFL-like conditions. Both monolithic and fractional-step methods are considered, with numerical examples corroborating our theory.

Keywords: Incompressible flow; IMEX methods; Variable viscosity; Generalised Newtonian fluids; Finite element method; Temporal stability

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