A Generalized Mac Scheme on Curvilinear Domains

Assistant Professor Yin-Liang Huang
Department of Applied Mathematics
National University of Tainan

We propose a simple finite difference scheme for Navier–Stokes equations in primitive formulation on curvilinear domains. With proper boundary treatment and interplay between covariant and contravariant components, the spatial discretization admits exact Hodge decomposition and energy identity. As a result, the pressure can be decoupled from the momentum equation with explicit time stepping. No artificial pressure boundary condition is needed. In addition, it can be shown that this spatially compatible discretization leads to uniform inf-sup condition, which plays a crucial role in the pressure approximation of both dynamic and steady state calculations.
Numerical experiments demonstrate the robustness and efficiency of our scheme.