

Parametric Model Order Reduction Development for Navier-Stokes Equations

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This talks focus on the parametric model order reduction development (pMOR) for Navier-Stokes equations. First, we introduce pMOR and demonstrate its success through 2D flow pass a cylinder. We then introduce two stabilization methods, constrained ROM (C-ROM) and Leray ROM (L-ROM) and applied to 2D lid-driven cavity problem at moderate Re and 3D Rayleigh Bénard convection at $Ra = 1.1e7$. We show both C-ROM and L-ROM outperforms Galerkin ROM (G-ROM). We next consider an error-indicated pMOR based on the time-averaged residual to a 2D unsteady convection. We demonstrate the error-indicated pMOR with Leray regularization is able to accurately predict the quantities of interests (QOIs) but also capture the bifurcation. Finally, we consider 3D turbulent pipe and channel flow with augmented basis method ROM (ABM-ROM). For 3D turbulent pipe flow, we show ABM-ROM is the most effective method comparing to other stabilization methods. For 3D turbulent channel flow, we show some preliminary results along with some diagnosis.