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POD STABILIZED METHODS FOR INCOMPRESSIBLE FLOWS: ERROR ANALYSIS AND COMPUTATIONAL RESULTS

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Proper orthogonal decomposition (POD) stabilized methods for the Navier-Stokes equations are considered and analyzed. We consider two cases: the case in which the snapshots are based on a non inf-sup stable method and the case in which the snapshots are based on an inf-sup stable method.

For both cases we construct approximations to the velocity and the pressure. For the first case, we analyze a method in which the snapshots are based on a stabilized scheme with equal order polynomials for the velocity and the pressure with local projection stabilization (LPS) for the gradient of the velocity and the pressure. For the POD method we add the same kind of LPS stabilization for the gradient of the velocity and the pressure as the direct method, together with grad-div stabilization. In the second case, the snapshots are based on an inf-sup stable Galerkin method with grad-div stabilization and for the POD model we also apply grad-div stabilization. In this case, since the snapshots are discretely divergence-free, the pressure can be removed from the formulation of the POD approximation to the velocity. To approximate the pressure, needed in many engineering applications, we use a supremizer pressure recovery method.

Error bounds with constants independent of inverse powers of the viscosity parameter are proved for both methods. Numerical experiments show the accuracy and performance of the schemes, also combined with a data-driven approach [1].

REFERENCES

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