

Towards Gradient-Robust Mixed Methods for the Incompressible Navier-Stokes Equations

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Mixed methods for the incompressible Navier-Stokes equations are reviewed with respect to the discretization of the divergence constraint. Though the establishment of inf-sup stable mixed methods represents a milestone in the development of discretization theory for flow problems, many important questions are left open, and classical text books usually convey a wrong impression what are they best qualitatively possible results, which are achievable in the field. Especially, it will be shown that the construction of gradient-robust mixed methods, whose velocity error is pressure-independent, is rather easy, though this was thought to be nearly impossible for many years. Numerical examples will show that classical mixed methods deliver poor results, whenever large irrotational forces appear in the Navier-Stokes momentum balance, while gradient-robust mixed methods perform well.

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