On conservation laws of Navier-Stokes Galerkin discretizations

Timo Heister*, Maxim A. Olshanskii† and Leo G. Rebholz*

* Department of Mathematical Sciences, Clemson University, Clemson, SC 29634
e-mail: (heister/rebholz)@clemson.edu

† Department of Mathematics, University of Houston, Houston TX 77004
e-mail: molshan@math.uh.edu

ABSTRACT

In the talk, we discuss conservation properties of Galerkin methods for the incompressible Navier-Stokes equations, without the divergence constraint strongly enforced. In typical discretizations such as the mixed finite element method, the conservation of mass is enforced only weakly, and this leads to discrete solutions which may not conserve energy, momentum, angular momentum, helicity, or vorticity, even though the physics of the Navier-Stokes equations dictate that they should. We aim to construct discrete formulations that conserve as many physical laws as possible without utilizing a strong enforcement of the divergence constraint. Doing so leads to a new formulation that conserves each of energy, momentum, angular momentum, enstrophy in 2D, helicity and vorticity. Further details can be found in [1].

REFERENCES

[1] Charnyi, S., Heister, T., Olshanskii, M. A., and Rebholz, L. G. On conservation laws of Navier-Stokes Galerkin discretizations. *arXiv preprint* arXiv:1605.09763, (2016).