Preconditioned iterative solvers for linear systems arising from IgA discretized incompressible NSE

H. Horníková*

* New Technologies for the Information Society (NTIS)
Faculty of Applied Sciences
University of West Bohemia
Univerzitní 8, 301 00 Plzeň, Czech republic
e-mail: hhornik@kma.zcu.cz

ABSTRACT

We deal with efficient techniques for numerical simulation of incompressible fluid flow based on the Navier-Stokes equations discretized using isogeometric analysis approach. Typically, the most time-consuming part of the simulation is solving the large saddle-point type linear systems arising from the discretization. These systems can be efficiently solved by Krylov subspace methods, but the choice of a good preconditioner is crucial.

In our preliminary study we test several Krylov subspace methods in combination with some preconditioners developed for the Navier-Stokes equations discretized by finite element method, which can be found in the literature. We analyze their efficiency for the linear systems arising from IgA discretization, which are usually less sparse compared to those from finite elements.

Our aim is to develop a fast solver for our specific problem of flow in a water turbine. It brings several complications like periodic boundary conditions at non-parallel boundaries and computation in a rotating frame of reference. This makes the system matrix even less sparse with more complicated sparsity pattern and some zero off-diagonal blocks of the matrix become non-zero.

REFERENCES

[1] A.Segal, M. ur Rehman, and C.Vuik, Preconditioners for Incompressible Navier-Stokes Solvers, *Numerical Mathematics: Theory, Methods and Applications*, Vol. **3**, pp. 245-275 (2010).

[2] X.He, and C.Vuik, Comparison of Some Preconditioners for the Incompressible Navier-Stokes Equations, *Numerical Mathematics: Theory, Methods and Applications*, Vol. **9**, pp. 239-261 (2016).