Pressure Approximation on Dynamic Meshes

Winnifried Wollner

The computational costs of numerically solving nonstationary flow problems are comparatively high due to the complex structure of such problems, especially when dealing with three-dimensional geometries.
Thus, it is crucial to apply adaptive refinement techniques to reduce the size of the approximative problem without reducing the accuracy of the approximation. To be most efficient in capturing the dynamics of a nonstationary flow problem, it is desirable to use so-called `dynamic meshes' for the discretization in space. That is, one uses possibly different meshes at different time points. In this way, one can efficiently resolve and track layers marching through the domain, for example. However, by doing so one will usually obtain pressure approximations that diverge when the size of the time step is reduced. In contrast, this behavior is not observed when one is concerned with the approximation of the velocities.

This talk is concerned with analyzing this defect in the approximation of the pressure on dynamically changing spatial meshes during the computation of nonstationary incompressible flows. This phenomenon is analyzed for discontinuous Galerkin finite element discretizations in time. We show that the observed behavior is due to the fact, that discrete solenoidal fields lose this property under changes of the spatial discretization. Finally we will consider several possible ways to circumvent this problem.