Time Discontinuous Galerkin Multipatch Isogeometric Analysis of Parabolic Problems

Ioannis Toulopoulos[1] Christoph Hofer[2] Ulrich Langer[3] Martin Neumüller[4]

In this talk, we present a time discontinuous Galerkin multipatch Isogeometric Analysis (dGIGA) scheme for solving linear parabolic problems. In our approach, we consider the time variable t as another variable, say x_{d+1}, and the time derivative as a convection term in the direction x_{d+1}. We derive the space-time weak formulation, by multiplying the Partial Differential Equation problem (PDE) by a test function depending on space and time variable. Using the resulting formulation, we define the dGIGA method. Precisely, the whole space time cylinder is described as a union of space-time patches (slabs). In every space-time patch, the problem is simultaneously and uniformly discretized in space and in time, without imposing continuity requirements of the B-spline spaces across the interfaces of the space-time patches. The communication of the patch-wise discrete solutions is ensured by introducing simple "up-wind" jump terms across the interfaces. For stabilizing the time discretization, the method incorporates ideas of streamline diffusion methodology. We prove stability of the discrete problem with respect to a suitable norm, and show a priori discretization error estimates in this norm. The method has been implemented in a parallel platform. We present few numerical examples that support our theoretical estimates. This talk is based on the joint work [1]. This work was supported by the Austrian Science Fund (FWF) under the grant NFN S117-03 and W1214-N15, project DK4.

References:

[1] C. Hofer, U. Langer, M. Neumüller, I. Toulopoulos, Time-Multipatch Discontinuous Galerkin Space-Time Isogeometric Analysis of Parabolic Evolution Problems (2017) under preparation.

[1] Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences, Computational Methods for PDEs, Linz, Austria,
ioannis.toulopoulos@oeaw.ac.at

[2] Institute of Computational Mathematics, Johannes Kepler University (JKU) Linz, Austria,
christoph.hofer@jku.at

[3] Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences, and JKU Linz, Austria,
ulrich.langer@ricam.oeaw.ac.at

[4] Institute of Computational Mathematics, Johannes Kepler University (JKU) Linz, Austria,
neumueller@numa.uni-linz.ac.at