Veranstaltungen im Sommersemester 2023

Das achtunddreißigste Treffen des Rhein-Main Arbeitskreises findet
Freitag, den 7. Juli 2023, ab 15:00 Uhr,

an der

TU Darmstadt
Fachbereich Mathematik
Dolivostraße 15

im **Raum S4|10-1** statt.

Programm

15:00 Uhr: Prof. Dr. Tabea Tscherpel (TU Darmstadt)
Mixed finite elements for incompressible fluids equations
For incompressible fluid equations, such as Stokes equations, on the discrete level the incompressibility constraint poses serious challenges. In mixed finite element methods the inf-sup condition ensures well-posedness of the saddle point problem and stability of the scheme. The existence of a divergence-preserving operator, a so-called Fortin operator, implies this condition. In the numerical analysis of non-linear problems, such as non-Newtonian fluid equations, it is particularly useful if the Fortin operator is local.

In this talk we introduce the setup of mixed finite element spaces. Then, we present a recent result on the construction of a local Fortin operator for the lowest order Taylor-Hood element, which gives rise to a reduced mixed element.

This talk is based on joint work with Lars Diening and Johannes Storn (Bielefeld University).

15:45 Uhr: Tee/Kaffee

16:15 Uhr: M. Sc. Dorian Vogel (Universität Marburg)
Adaptive Quarklet Tree Approximation
We are concerned with a polynomially enriched wavelet frame, a so-called quarklet frame. This frame is constructed from a finite set of functions by translation, dilation and multiplication by monomials and can be used to design schemes that resemble hp-versions of adaptive wavelet methods for the numerical treatment of elliptic partial differential equations. In this talk we investigate near-optimal approximation of a given L_2-function. Inspired by hp-approximation techniques of Binev, we use the underlying tree structure of the frame elements to derive an adaptive algorithm that can be used to create approximations with an error close to the best tree approximation error for a given cardinality. This approach can be used to achieve inverse-exponential convergence rates (with respect to the degrees of freedom spent) for models of typical solutions of partial differential equations where we expect that adaptive schemes outperform classical uniform schemes.

17:00 Uhr: Prof. Dr. Mathias Staudigl (Universität Mannheim)

A relaxation-based probabilistic approach for PDE-constrained optimization under uncertainty with pointwise state constraints

We consider a class of convex risk-neutral PDE-constrained optimization problems subject to pointwise control and state constraints. Due to the many challenges associated with almost sure constraints on pointwise evaluations of the state, we suggest a relaxation via a smooth functional bound with similar properties to well-known probability constraints. First, we introduce and analyze the relaxed problem, discuss its asymptotic properties, and derive formulae for the gradient the adjoint calculus. We then build on the theoretical results by extending a recently published online convex optimization algorithm (OSA) to the infinite-dimensional setting. Similar to the regret-based analysis of time-varying stochastic optimization problems, we enhance the method further by allowing for periodic restarts at pre-defined epochs. Not only does this allow for larger step sizes, it also proves to be an essential factor in obtaining high-quality solutions in practice. The behavior of the algorithm is demonstrated in a numerical example involving a linear advection-diffusion equation with random inputs. In order to judge the quality of the solution, the results are compared to those arising from a sample average approximation (SAA). This is done first by comparing the resulting cumulative distributions of the objectives at the optimal solution as a function of step numbers and epoch lengths. In addition, we conduct statistical tests to further analyze the behavior of the online algorithm and the quality of its solutions. For a sufficiently large number of steps, the solutions from OSA and SAA lead to random integrands for the objective and penalty functions that appear to be drawn from similar distributions.

This is joint work with Drew Kouri and Thomas Surowiec.

Link to the paper: https://link.springer.com/article/10.1007/s10589-023-00461-8

anschließend: Nachsitzung im Restaurant Cani am Bahnhof Darmstadt (ca. 18:20 Uhr)

Falls Sie an der Nachsitzung teilnehmen möchten, geben Sie bitte spätestens bis zum 28.06. Frau Dehnert (dehnert@mathematik.tu-darmstadt.de) Bescheid.