Graduate School of Computational Engineering

Interdisciplinary Research Excellence

Topics and Research Activities of the Graduate School of Computational Engineering

Research Activities
- Highly innovative research projects
- Innovative research program based on close interaction of methods and applications
- Research Focus on Multiphase Flows, OpenFOAM Conference in Darmstadt
- Demonstrative Applications: Wind energy plant, Fluid-Structure-Interaction
- Communication systems and Optimization
- Discontinuous Galerkin Method in Electromagnetics and Flow Dynamics
- Best paper awards and other prizes of affiliated researchers

Requirements
- Mathematical theory
- Complex models
- Experimental investigations

Scientific Highlights

Optimal Flow Control based on PDE and an application to the cancellation of Tollmien-Schlichting waves
GSC Student: Jan Gläser; Supervisor: Ulbrich (Numerical Optimization and Optimal Control), Co-Supervisor: Thorwart (Fluid Mechanics and Aerodynamics)

Description:
- Cancellation of Tollmien-Schlichting waves in the boundary layer of a flat plate
- Control of the flow by a body force induced by a plasma actuator
- Close cooperation with experiments and numerical investigations

Methods/Results:
- Proper Orthogonal Decomposition for the low-order description of the flow
- Special snapshot ensemble applicable to optimal control problems
- A-priori error estimator
- Design of a feedback controller with Model Predictive Control
- Numerical experiments

Pumping principle of a valveless micropump

Description:
- Application: Valve-less micropumps for industry and medical applications
- Main challenge: High-precision control of complex fluids and their interactions with static walls
- Development of an efficient numerical framework for analysis and design of micropumps

Methods/Results:
- Kinematic and fluid-structure interaction (both PDE-level)
- High-precision control of non-Newtonian fluid flows
- Kinematic and fluid-structure interaction, both PDE-level

Methods for Higher Order Numerical Simulations of Complex Inviscid Fluids
GSC Student: Björn Müller; Supervisor: M. Oberlack (Fluid Dynamics), Co-Supervisor: S. Schnepp (Computational Electromagnetics)

Description:
- Application: Compressible single- and multiphase flows with immersed interfaces
- Challenges: Efficient numerical integration over the complex and strongly curved zero level set with high accuracy

Methods/Results:
- Discontinuous Galerkin Method
- Non-smooth enrichment of the basis functions
- Improved numerical integration by mean of hierarchical moment-fitting

Pressure distribution at an end plate in a circular domain defined by a zero level set (red)

Corresponding convergence study revealing an experimental order of convergence of p=1

Research Environment

International and industrial Cooperations

Technische Universität Darmstadt
Graduate School of Computational Engineering
Dolivostraße 15, 64293 Darmstadt
www.graduate-school-ce.de