Part I

Constrained Optimization, Identification and Control

Introduction to Part I
Constrained Optimization, Identification and Control

This part presents novel algorithmic developments within the priority program for the efficient solution of PDE constrained optimization, identification and control problems.

Eberhard Bänsch and Peter Benner consider, in *Stabilization of Incompressible Flow Problems by Riccati-based Feedback*, optimal control-based boundary feedback stabilization of flow problems for incompressible fluids and present algorithmic advances in solving the associated algebraic Riccati equations.

Luise Blank, Martin Butz, Harald Garcke, Lavinia Sarbu and Vanessa Styles formulate, in *Allen-Cahn and Cahn-Hilliard Variational Inequalities Solved with Optimization Techniques*, time stepping schemes for Allen-Cahn and Cahn-Hilliard variational inequalities as optimal control problems with PDE and inequality constraints and apply a primal dual active set strategy for their solution.

Hans Georg Bock, Andreas Potschka, Sebastian Sager and Johannes Schlöder study, in *On the Connection between Forward and Optimization Problem in One-shot One-step Methods*, the relation between the contraction of the forward problem solver and simultaneous one-step optimization methods. They analyze strategies to ensure convergence under appropriate assumptions and show that in general the forward problem solver has to be used with adaptive accuracy controlled by the optimization method.

Debora Clever, Jens Lang, Stefan Ulbrich and Carsten Ziems present, in *Generalized Multilevel SQP-methods for PDAE-constrained Optimization Based on Space-Time Adaptive PDAE Solvers*, an adaptive multilevel optimization approach for complex optimal control problems with time-dependent nonlinear PDAEs and couple it with the PDAE-solver KARDOS. The algorithm is applied to a glass cooling problem with radiation.

Thomas Franke, Ronald H. W. Hoppe, Christopher Linsenmann and Achim Wixforth combine, in *Projection Based Model Reduction for Optimal Design of the Time-dependent Stokes System*, concepts of domain decomposition and model reduction by balanced truncation for the efficient solution of shape optimization problems where the design is restricted to a relatively small portion of the computational domain. The approach is applied to the optimal design of capillary barriers as part of a network of microchannels and reservoirs on microfluidic biochips.

Nicolas Gauger, Andreas Griewank, Adel Hamdi, Claudia Kratzenstein, Emre Özkaya and Thomas Slawig consider, in *Automated Extension of Fixed Point PDE Solvers for Optimal Design with Bounded Retardation*, PDE-constrained optimization problems where the state equation is solved by a pseudo-time stepping or fixed point iteration and develop a coupled iteration for the optimality system with the goal to achieve bounded retardation compared to the state equation solver.

Martin Gugat, Michael Herty, Axel Klar, Günter Leugering and Veronika Schleper present, in *Well-posedness of Networked Hyperbolic Systems of Balance*

Laws, an overview on recent existence, uniqueness and stability results for hyperbolic systems on networks based on wave-front tracking.

Michael Hinze, Michael Köster and Stefan Turek combine, in *A Space-Time Multigrid Method for Optimal Flow Control*, a Newton solver for the treatment of the nonlinearity with a space-time multigrid solver for linear subproblems to obtain a robust solver for instationary flow control problems. The algorithm is applied to several test cases.

Michael Hinze and Morton Vierling address, in *A Globalized Semi-smooth Newton Method for Variational Discretization of Control Constrained Elliptic Optimal Control Problems*, the implementation, convergence and globalization of semismooth Newton methods for elliptic PDE-constrained optimization with control constraints.

Denise Holfeld, Philipp Stumm and Andrea Walther summarize, in *Structure Exploiting Adjoints for Finite Element Discretizations*, details for the development, analysis, and implementation of efficient numerical optimization algorithms using algorithmic differentiation (AD) in the context of PDE constrained optimization. In particular, multistage and online checkpointing approaches are considered.

Ekaterina Kostina and Olga Kostyukova propose, in *Computing Covariance Matrices for Constrained Nonlinear Large Scale Parameter Estimation Problems Using Krylov Subspace Methods*, an algorithm for the fast computation of the covariance matrix of parameter estimates, which is crucial for efficient methods of optimum experimental design.

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