Biannual Report 2011/2012

Department of Mathematics – Research Group Optimization

TECHNISCHE
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Contents

Introduction

This document contains a subset of the information contained in the biannual report of the Department of Mathematics at TU Darmstadt for 2011 and 2012. It has simply be obtained by taking all the information from the research group optimization supplied to the complete report. All empty chapters have been removed. This is only meant to be supplementary, because it is hard to filter out information from the complete document. No optimization of the layout has been performed.

Research Group Optimization, March 2012

2 Research

2.1 Overview

2.1.1 Collaborative Research Centre SFB 568

The Collaborative Research Centre SFB 568 “Flow and Combustion in Future Gas Turbine Combustion Chambers" started in 2001 and aims at the formulation of an integral model for the development and optimization of new gas turbine combustion chamber concepts which make more efficient use of rare resources in the conversion of energy compared to today’s technology. The main points that have to be regarded are the occuring and highly complex coupled and interacting physico-chemical processes such as turbulent transport, two- or multi-phase flows, materials transport, chemical reactions/combustion and radiation. The integral model comprises four main elements:

1. submodels of physical/chemical mechanisms and interactions
2. suitable numerical methods
3. consideration of basic conditions and neighboring components and interactions
4. implementation of targeted validation experiments

The Department of Mathematics contributes to the SFB 568 within two subprojects (Lang, Ulbrich). The topics under investigation are the control of errors of the numerical simulation, model reduction techniques and the numerical optimization of gas turbine relevant problems. To control and estimate errors of the complex numerical simulations, grid refinement strategies based on suitable error estimators are investigated. To reduce the cost of the simulations, model reduction techniques are further developed to account for turbulence (Lang). Since the simulation itself is a challenging task, new mathematical techniques for the optimization have to be developed that make optimization applicable in reasonable time (Ulbrich).

2.1.2 Collaborative Research Centre SFB 666

The Collaborative Research Centre SFB 666 “Integral Sheet Metal Design with Higher Order Bifurcations”, established in 2005, considers the enormous prospective potential of the new technique linear flow splitting for sheet metal and develops methodical tools to integrate this technique into the product development processes. The collaborative research centre SFB 666 is currently in its second funding period, the proposal for the third has just been evaluated.
The investigated technologies of the SFB, linear flow splitting and linear bend splitting, make it possible to produce branched sheet metal products in integral style. Hereby the disadvantages of conventional procedures to create branched sheet metal structures, e.g., gluing or welding, can be avoided. The SFB is structured into the four main units of development, production, evaluation and synthesis. In each of these units,

new methodologies, techniques and proceedings arise. They cope with all occurring unique requirements of this new product category. Engineers are involved in the research center as well as mathematicians and material scientists. This interdisciplinary research environment has lead to novel product development methodologies by combining engineering expertise with mathematical modeling and optimization methods. The Department of Mathematics participates in the SFB 666 within three sub-projects (Kohler, Pfetsch, Ulbrich). The mathematical research is concentrated on development and on evaluation. In the product development process, the aim is to provide an optimal design of the desired product as well as an optimal process control of selected forming methods. This is done by means of discrete optimization and PDE-constrained nonlinear optimization. In the evaluation process, statistical methodologies are used to provide estimates for relations between properties of the considered sheet metal part and its structural durability. Thus, a smaller number of costly and time consuming experiments have to be carried out.

2.1.3 Collaborative Research Centre SFB 805

The Collaborative Research Centre SFB 805 “Control of Uncertainties in Load-Carrying Structures in Mechanical Engineering" was established in January 2009. The second funding period started in January 2013. Its main objective is the development of methods and techniques to control uncertainties in the development, production and usage of load-carrying structures to significantly enhance their safety, reliability and economic efficiency. While uncertainty cannot be avoided or eliminated, its influence during the product lifecycle—from material properties to production and usage—can be controlled and hence minimized. Especially in the area of light-weight construction, the trade-off between low weight and low production cost on one hand and adequate load-bearing capacity on the other hand makes the influence of uncertainties critical. Hence, the control of uncertainty is of significant importance and is therefore a focus of the research to be conducted by the SFB 805.

The control of uncertainty through the entire process chain of development, production and usage necessitates a close interdisciplinary cooperation of engineers and mathematicians. Within the collaborative research centre, the engineering sciences address uncertainty in terms of physical and technical phenomena, whereas the mathematical research assesses the influence and effects of uncertainty and its interdependencies and derives from this optimal solution strategies for processes with minimal uncertainty and optimal design concepts for load-carrying systems.

The Department of Mathematics is involved in three projects of SFB 805 (Lorenz, Pfetsch, Ulbrich). To deal with uncertainty, the tool of robust optimization is applied, where complex products are optimized while controlling inherent uncertainty already in the product development phase. Uncertainty may occur because of uncertain loadings, uncertain material properties or unknown user behavior. Furthermore, the SFB 805 examines the use of active elements to react on uncertainty in a load-carrying system. The question of optimal placement of active elements in the structure is a challenging nonlinear mixed-integer optimization problem. In the production process, the optimization of process chains under uncertainty is considered in order to reduce costs and uncertainty caused by uncertain market conditions.

2.1.4 The LOEWE Centre AdRIA

The LOEWE Centre “AdRIA: Adaptronics: Research, Innovation, Application” was established in 2008 and is funded with an amount of 34 million Euro for 6 years by the State of Hesse within the research support program LOEWE-Landes-Offensive zur Entwicklung Wissenschaftlich-Ã¶konomischer Exzellenz. It is an interdisciplinary collaboration of Fraunhofer LBF, TU Darmstadt and Hochschule Darmstadt.
The aim of the LOEWE Centre AdRIA is the scientific and technological study of adaptronic systems in order to ensure a systematic and holistic development of advanced adaptronic products. A particular emphasis is the development of light weight structures based on adaptronic systems with improved energy efficiency, functionality and performance. The LOEWE Centre AdRIA is structured into several technology areas in order to advance basic research as well as three exemplary technological demonstrator applications.
The Department of Mathematics participates in the Centre within the technology area “Simulation Tools” (Ulbrich) and contributes to the development of optimization methods for adaptronic systems, in particular the optimal placement and control of sensors, actuators and active absorbers.

2.1.5 LOEWE Priority Program Cocoon

The LOEWE Priority Program “Cooperative sensor communication (Cocoon)” was established in January 2011 and is funded with an amount of 4.5 million Euro for 3 years by the State of Hesse. The grant was secured within the frame of the third round of the research support program LOEWE-Landes-Offensive zur Entwicklung Wissenschaftlich-Ã¶konomischer Exzellenz.
Research in the field of wireless sensor communication will enable us to make an essential contribution to the improvement of our daily life. Sensors we consider in our research include environmental sensors, mobile phones, PDAs, navigation equipment, car keys, electronic purses or pulse rate measurement devices. New diverse applications, which can be integrated into the context of a smart city, will arise. This concept requires an intelligent environment in which daily life supporting services are ubiquitous.
The Department of Mathematics participates in the LOEWE Priority Program within a sub-project (Ulbrich). The mathematical research considers the development of efficient discrete-continuous optimization methods for the optimal design of wireless communication networks, which leads to challenging nonconvex mixed-integer polynomial optimization problems.

2.2 Research Groups

2.2.1 Optimization

The research group **Optimization** consists of the groups **Algorithmic Discrete Mathematics**, **Discrete Optimization**, and **Nonlinear Optimization**, which cooperate closely. Mathematical Optimization considers the development, analysis, and application of efficient numerical methods for minimizing (or maximizing) a function under constraints. While Discrete Optimization studies mainly linear or convex problems involving integer variables, Nonlinear Optimization focuses on nonlinear problems with continuous variables. The research group covers both research topics in a comprehensive way and cooperates in particular in the challenging field of Mixed Integer Nonlinear Programming, which considers nonlinear optimization with mixed discrete-continuous variables.

Algorithmic Discrete Mathematics combines aspects of pure and applied mathematics. The group focuses on geometric combinatorics with links to graph algorithms, linear and integer programming, toric and tropical algebraic geometry and related areas.
We develop mathematical software for research in mathematics and beyond.

Discrete Optimization has become an important component in modern applied mathematics. Many problems from business and industry can be modeled as discrete optimization problems. The development of solution methods for these problems is the main focus of the group Discrete Optimization. This includes the development of mathematical models of real-world problems, the theoretical analysis (using methods mainly from graph theory, polyhedral combinatorics, and integer programming), and the design and implementation of fast algorithms as well as their evaluation in practice.
Experiences of the group are, for instance, in the following applied areas: public mass transportation (line planning, disruption management), energy optimization (gas transport), or optimization in mechanical engineering (truss topology optimization), see the projects for details.

Nonlinear Optimization is nowadays an important technology in applied mathematics, science, and engineering. Nonlinear optimization problems appear in many applications, e.g., shape optimization in engineering, robust portfolio optimization in finance, parameter identification, optimal control, etc. Nonlinear Optimization has emerged as a key technology in modern scientific and industrial applications. Challenging are in particular optimization problems with partial differential equations as constraints (PDE-constraints), for example optimization problems for flows, transport problems, diffusion processes, wave propagation, or mechanical structures. An efficient solution of such problems requires highly developed optimization methods, which use modern adaptive multilevel techniques of scientific computing.
The research group Nonlinear Optimization considers the development, theory, implementation, and application of efficient algorithms for nonlinear optimization. Particular research topics are PDE-constrained optimization, large scale optimization, adaptive multilevel techniques, preconditioning, global optimization, and relaxation of discrete problems.

The research group Optimization is engaged among others in the Excellence Cluster EXC 259 *Center of Smart Interfaces*, the Graduate School (Excellence Initiative)

GSC 233 *Computational Engineering: Beyond Traditional Sciences*, the Collaborative Research Center (SFB) 568 *Flow and Combustion in Future Gas Turbine Combustion Chambers*, the Collaborative Research Center (SFB) 666 *Integral Sheet Metal Design with Higher Order Bifurcations - Development, Production, Evaluation*, the Collaborative Research Center (SFB) 805 *Control of Uncertainties in Load Carrying Systems of Mechanical Engineering*, the LOEWE-Center *AdRIA: Adaptronik: Research, Innovation, Application*, the International Research Training Group IGK 1529 *Mathematical Fluid Dynamics*, and the German Research Foundation (DFG) Priority Programme SPP 1253 *Optimization with Partial Differential Equations*. In addition, the group has various industry partners, including cooperations with Open Grid Europe and Schenck.

Project: Adaptive Multilevel SQP-Methods for PDAE-Constrained Optimization with Restrictions on Control and State

The project is part of the DFG-Priority Program SPP 1253 “Optimization with Partial Differential Equations”.
We extend the adaptive multilevel SQP-method for control-constrained optimal control problems of Ziems and Ulbrich, see [3] or [5], to state-constrained optimal control problems governed by PDAEs. To this end, we combine the Moreau Yosida regularization with the adaptive SQP method. The refinement conditions and the penalty parameter update are modified specifically. We ensure that the regularized subproblems satisfy the assumptions of the adaptive SQP method and that the combined algorithm is well-posed. Based on the convergence theory for the Moreau Yosida regularization of Meyer and Yousept [4] and the SQP method of Ziems and Ulbrich [6] or [5], we deliver a new first order necessary optimality result for the output of the combined algorithm [1].
Additionally we include a reduced-order model based on POD combined with DEIM in the adaptive SQP method. This reduces the computational effort significantly.
The algorithm is implemented for an application in glass manufacturing by Clever, Lang and Schröder, see [2].

Partner: Debora Clever, Jens Lang and Dirk Schröder, TU Darmstadt

Support: Graduate School GSC 233: “Computational Engineering”

Contact: Stefanie Bott, Stefan Ulbrich, Jan Carsten Ziems

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Project: Optimal Flow Control based on Reduced Models

Tollmien-Schlichting waves are responsible for the laminar-turbulent transition in a flat plate boundary layer. By damping these waves, a significant reduction of drag can be achieved. Motivated by an experiment conducted in the windtunnel at the institute SLA, the objective is to dampen Tollmien-Schlichting waves using a body force which is induced by a plasma actuator. These actuators induce a body force which leads to a fluid acceleration, so the velocity profile is changed next to the surface. By optimal control of the plasma actuator parameters it is possible to reduce or even cancel the Tollmien-Schlichting waves and delay the turbulence transition.
We use a Model Predictive Control (MPC) approach for the cancellation of Tollmien-Schlichting waves in the boundary layer of a flat plate. The model that predicts the next flow field in a time horizon, has to fulfill the Navier-Stokes equations. Instead of solving a high-dimensional system, a low-order model description is used to perform the optimization. The reduced-order model is obtained with a Galerkin projection and an appropriate basis. We use Proper Orthogonal Decomposition (POD) in which the basis function are generated from numerical solutions. The optimization of the control parameters is performed within the reduced system. The efficiency of the reduced-order controller is demonstrated for the damping of Tollmien-Schlichting waves by plasma actuators.

Partner: Institute of Fluid Mechanics and Aerodynamics (SLA), Institute of Numerical Methods in Mechanical Engineering (FNB)

Support: Graduate School GSC 233: “Computational Engineering”

Contact: Jane Ghiglieri, Stefan Ulbrich

Project: Adaptive Multigrid Methods for Fluid-Structure Interaction Optimization

Strong fluid structure coupling is part of many technical systems. The aim of this project is to develop an efficient adaptive multilevel algorithm to solve an optimization problem governed by Fluid-Structure Interaction (FSI).
This algorithm should combine modern techniques of PDE-constrained optimization, adaptivity and Fluid-Structure Interaction simulation. Since for elliptic as well as for parabolic partial differential equations an adjoint based Trust-Region SQP method has shown good results, we want to adapt this method. Thus we aim for an adjoint based algorithm that is able to refine the given grids (both the spatial and the temporal) adaptively during the optimization process.
The Fluid-Structure Interaction problem we consider as the constraint for the optimization problem, is in the weak form of the FSI problem considered in an Arbitrary-Lagrangian-Eulerian (ALE) framework. The coupling of the two parts of the partial differential equation is performed via strong coupling.
Accordingly, the adjoint equation is considered in an ALE framework and in a strongly coupled way.

Partner: Graduate School GSC 233: “Computational Engineering”

Support: German Research Foundation (DFG)

Contact: Sarah Essert, Michael Schäfer, Stefan Ulbrich

Project: Mathematical methods and models for the optimal combination of active and passive components in trusses (project A4 of Collaborative Research Centre (SFB) 805)

This project is part of the Collaborative Research Centre (SFB) 805 *Control of uncertainty of load carrying systems in mechanical engineering*. The project deals with the optimal design of mechanical trusses under uncertainty. Trusses are important in many applications (undercarriages of airplanes, bicycles, electrical towers, etc.) and are often overdimensioned to withstand given forces under several uncertainties in loadings, material and production processes. Active parts (e.g., piezo-elements) can react on these uncertain effects and reduce the dimension of trusses. The Collaborative Research Centre (SFB) 805 introduces new technologies to handle uncertainty in load carrying systems. The aim of this project is to find optimal combinations of active and passive parts in a mechanical truss under several types of uncertainty, e.g. uncertainty in loadings, material, production processes or malfunction of complete bars. Mathematically, this leads to mixed-integer nonlinear semidefinite problems. For this kind of problem, there exist no solvers that exploit the structure of the problem efficiently. Besides the development of an appropriate solver another focus lies in a mathematical handling of the upcoming uncertainties. For example, ellipsoidal and polyhedral sets will be used to integrate uncertainty in different loading scenarios. All of this includes interdisciplinary communication to mechanical engineers to achieve realistic models.

Partner: Collaborative Research Center (SFB) 805: “Control of Uncertainty of load carrying structures in mechanical engineering”; speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Kai Habermehl, Sonja Mars, Marc Pfetsch, Stefan Ulbrich

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Project: Generation of Certificates for the Infeasibility of technical Capacities

This project is part of the BMWi cooperative project “Investigation of the technical capacities of gas networks”, in which six research partners, the gas transportation company Open Grid Europe, and the German Federal Network Agency (Bundesnetzagentur) are involved. The technical capacities determine bounds on the amount of gas that can be charged into or discharged from a gas network. Therefore, a central aspect is to compute the technical capacities.

In our sub-project, we want to determine so-called certificates for the infeasibility of certain gas nominations. For the analysis of technical capacities one has to decide which requests can be handled by the network. If a certain nomination cannot be transported, one wants to know the reason why this nomination is infeasible. Thus a

justification is required, i.e., a certificate that is easy to understand. This should be possible without the need for involved simulations or computations. We will concentrate on the development of methods to find such certificates and apply them to the analysis of technical capacities.

Partner: Zuse-Insitute Berlin, Universität Hannover, Universität Duisburg-Essen, Humboldt-Universität Berlin, Universität Erlangen-Nürnberg, German Federal Network Agency (Bundesnetzagentur), Open Grid Europe

Support: German Federal Ministry of Economics and Technology (BMWi)

Contact: Imke Joormann, Marc Pfetsch

Project: FORNE

In this project, we deal with gas network optimization, together with our industrial partner Open Grid Europe (OGE). The goal is to provide tools for the mid to long term planning of gas networks. One main step deals with the question to decide whether a given amount of gas and given bounds on the pressure can be transported in a stationary gas network. Furthermore, the extension of the existing gas network topology is considered. We develop algorithms that provide solutions to the corresponding mixed-integer nonconvex, nonlinear optimization problems. The methods are tested on the real-world instances of OGE.

Partner: Zuse-Insitute Berlin, Universität Hannover, Universität Duisburg-Essen, Humboldt-Universität Berlin, Universität Erlangen-Nürnberg, Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS) Berlin, Open Grid Europe

Contact: Imke Joormann, Marc Pfetsch

Project: `polymake`

The mathematical software system `polymake` provides a wide range of functions for convex polytopes, simplicial complexes, and other objects.
While the system exists for more than a decade it was continuously developed and expanded. The most recent version fundamentally changes the way to interact with the system. It now offers an interface which looks similar to many computer algebra systems. However, on the technical level `polymake` differs from most mathematical software systems: rule based computations, a flexible object hierarchy and an extendible dual Perl/C++ interface are the most important characteristics. There are interfaces to programs written in C, C++, Java, and Perl.
`polymake` is an open source software project. The current version 2.12 can be downloaded freely from `www.polymake.org`.

Partner: Ewgenij Gawrilow (TomTom N.V.) and the `polymake` team

Contact: Michael Joswig

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Project: Symmetries in Linear and Integer Linear Programming

It is a known fact that many standard (integer) linear programming formulations of relevant problems in optimization exhibit a lot of symmetry. In this situation a standard branch-and-cut framework repeatedly enumerates symmetric solutions, and sometimes this renders such methods useless. To address these issues the last decade saw a number of approaches to devise algorithms specialized to symmetric optimization problems, see e.g. Ostrowski et al. [2].
We tackle the problem from a geometric and group theoretic view point. Basic properties of linear representations of finite groups can be used to reduce symmetric linear programming to solving linear programs of lower dimension. Combining this approach with knowledge of the geometry of feasible integer solutions yields an algorithm for solving highly symmetric integer linear programs which only takes time which is linear in the number of constraints and quadratic in the dimension. We also extend this approach to integer linear programs that are symmetric with respect to products of groups.

Support: Studienstiftung des deutschen Volkes

Contact: Michael Joswig, Katrin Herr

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Project: SFB 805, project B1, Optimization of process chains under uncertainty

The aim of this project is to determine optimal process chains, as well as mastering uncertainties which occur in process chains and process networks. Uncertainties e.g. occur when non-deterministic variations of geometry or material influence the strength of a stick in a stick system. Uncertainties also occur in form of imprecise sales-forecasts. These imprecisions have direct consequences on production techniques.
In the context of this subproject, optimal process chains for the production of devices are to be determined. We can examine various objectives for this purpose, e.g. the minimization of production costs subject to compliance with certain tolerances of quality. Another objective may be to maximize the profits under consideration of variations in the market. In the SFB 805, we find on various levels process chains flawed with uncertainties. The first task is to develop mathematical models that embrace the problems of practice. In this project, we assume that we can model the inherent uncertainties of process chains with the help of distributions over future random scenarios. A discretization of a distribution leads us to a model described by high dimensional mixed-integer linear programs. These programs have block-structured constraint-matrices, where blocks represent possible scenarios which are coupled via some decision variables. The number of scenarios can be reduced with the help of suited reduction methods so that the resulting mixed-integer program turns out to be manageable in many cases.
Additionally, approximation algorithms and heuristic procedures, which can work without constructing the enormously large stochastic programs, are to be examined. A more efficient description of the multi-stage stochastic problems can be exploited in these cases. The resulting slim problems are often PSPACE-hard, and have strong similarities to non-stochastic 2-person games. The aim, however, is to avoid an exponential

blow up in the size of the input description as it occurs, when stochastic programs are transformed to their deterministic equivalents.

Partner: Collaborative Research Center (SFB) 805: "Control of Uncertainty of load carrying structures in mechanical engineering"; Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Thorsten Ederer, Ulf Lorenz

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Project: GOmputer: the GO machine

The ability to compete with humans in playing games, most prominently chess, has been a longstanding touchstone for machine intelligence. In 1997, IBM's chess machine Deep Blue defeated Garry Kasparov, the highest-rated chess player ever [1]. Since then, several chess machines have been developed that are able to compete with human top players; the world's strongest one presumably being our own development Hydra [2, 3]. In contrast, computer programs for the Asian board game GO are still rather weak, which is often attributed to GO's orders of magnitude greater complexity - in terms of possible board positions and moves. While cracking GO remains an open challenge [5], in the last years GO programs also began to serve as test beds for the evaluation of developments in areas such as game tree search, pattern recognition, and machine learning.

The GOmputer project aims at the investigation of novel algorithmic approaches for playing GO and the development of a parallelized and hardware-accelerated GO machine prototype. From our previous work and experience, especially the world's strongest chess machine Hydra, we know that the interplay of research and development efforts between game algorithms and modern parallel computing architectures is a necessity to achieve a competitive GO machine. On the longer term, this project should lay the foundation for the development of the world's strongest GO machine [4].

The proposed PhD project is co-supervised by Ulf Lorenz, TU Darmstadt, and Marco Platzner, University of Paderborn.

Partner: Prof. Dr. Marco Platzner and Lars Schaefers, Universität Paderborn

Support: Microsoft, Universität Paderborn

Contact: Ulf Lorenz

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Project: Uncertainties in the structure finding process of hydrostatic consumers

A present demand of hydrostatics in car power-trains is the minimization of losses for valve-controlled consumers. One strategy to achieve the goal is that the displacement controller avoids resistant losses. For cost and functional reasons this way is not satisfactory for all situations. The focus is now on the question how future valve controls will look like. Beyond the structure of the hardware, the question arises, how the the used valves can be operated. An analysis of current operating strategies shows no systematics which control strategy is well fitting for which situation.
Thus the task is to find a hardware structure of valves of different types and a control algorithm for it such that losses are minimized under consideration of functionality, load profiles, demanded precision, energetic losses and costs.

Partner: Prof. Dr.-Ing. Peter Pelz, TU Darmstadt, Institut für Fluidsystemtechnik

Support: Collaborative Research Center (SFB) 805

Contact: Ulf Lorenz

Project: System optimization of the heating plant in the Darmstadtium

This is a pre-project for a larger project in cooperation with VDMA. Algorithmic optimization methods are used for the system design of heating plants and the current heating plant of the Darmstadtium is evaluated. Questions of the carrier in the Darmstadtium are: Is the wood heating boiler efficiently used? Does the hydraulic separator work as it should do? How should own heating and long-distance heating be mixed? Is the buffer storage intelligently used?

Partner: Prof. Dr.-Ing. Peter Pelz, TU Darmstadt, Institut für Fluidsystemtechnik

Support: VDMA

Contact: Ulf Lorenz

Project: Extension of mathematical Optimization Methods to solve PSPACE-complete Problems with the Help of Quantified Linear Programs

For classic optimization, it is assumed that the input of a problem is known before the computation starts. In practice, however, we are often in a situation where a part of the input data is afflicted with uncertainties or only estimations are known in advance. Many interesting optimization problems become PSPACE-complete as soon as even only most simple uncertainties are incorporated into the description of the input data. There are various approaches under research in the area of optimization under uncertainty. Relatively unexplored are the opportunities of quantified extensions of linear programs where some of the variables are universally quantified and the others extistentially. Such extended linear programs are called quantified linear programs (QLP). QLPs where the variables must be integer, are called quantified integer programs (QIP) and the QIP problem is PSPACE complete.
The aim of this research is to extend methods and insights of Mathematical Optimization such that they can be used to solve QIPs and QLPs. It is to be examined in how

far QLPs and QIPs are useful tools in order to describe interesting problems from practice and in how far solution algorithms can be presented which lead to impressive results, in the same way as MIP-solvers have already shown for NP-complete problems of practice.

Support: German Research Foundation (DFG)

Contact: Ulf Lorenz, Thomas Opfer

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Project: Triangulations and other decompositions of lattice polytopes in toric and tropical geometry

Lattice polytopes are objects at a junction between combinatorics and algebraic geometry. The study of their triangulations, coarsest subdivisions, mixed subdivisions, and other decompositions is motivated by the mutual interaction between these fields as well as by applications in number theory, optimization, statistics, mathematical physics, and algorithmic biology.
Attacking fundamental open problems in this area requires to combine theoretical insight with algorithmic ingenuity and computer experiments. Specific topics addressed in this project include the following: unimodular triangulations of lattice polytopes (in particular, matroid polytopes), the relationship between smoothness and normality of a toric variety, combinatorial and geometric interpretations of h^*-polynomials, and symmetric lattice polytopes.

Partner: Priority Program 1489 “Algorithmic and Experimental Methods in Geometry, Algebra, and Number Theory”; speaker: Wolfram Decker

Support: German Research Foundation (DFG)

Contact: Michael Joswig, Andreas Paffenholz

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[5] M. Joswig and G. M. Ziegler. Foldable triangulations of lattice polygons. arXiv:1207.6865.

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Project: Algorithmic Methods in Combinatorial Topology

Algorithmic problems are fundamental to low-dimensional topology; key examples include testing two spaces for topological equivalence, or identifying the topology of a space from a given triangulation. Although solutions to many such problems are known, the methods are often infeasibly slow, impractically complex, and difficult to implement. Central to many of these algorithms is the "projective solution space", a

highdimensional polytope (analogous to a 3-D polyhedron or 2-D polygon) that encodes a large amount of topological information. Our primary goal is to study the structure of this polytope, yielding new insights into the difficulty of these algorithmic problems, and developing new algorithms that allow these problems to be used effectively in practical experimentation. In particular, we will: - develop new algorithms to locate vertices of the polytope that hold particular topological significance; - develop a direct, efficient approach to determine the logarithmic limit set of the deformation variety, yielding significant geometric insights into the topological space under investigation; - gaining a clear understanding of the combinatorial complexity of the polytope, in particular the "admissible region" in which the most important topological information is located. Outcomes will include not only research papers, but also fast, accessible mathematical software for use by the wider research community. Such software is needed in practical applications of topology, such as DNA knotting and mathematical physics.

Partner: Dr. Benjamin Burton (University of Queensland, Brisbane), Prof. Stephan Tillmann (University of Sydney)

Support: “Go8 Australia-Germany Joint Research Co-operation Scheme”, German Academic Exchange Service (DAAD)

Contact: Michael Joswig, Andreas Paffenholz

Project: Mixed-Integer nonlinear models in wireless networks

This project is part of the LOEWE Priority Program Cocoon (Cooperative Sensor Communication) supported by the LOEWE research initiative of the state of Hesse/Germany.
In this project we explore the utilization of mixed-integer optimization in wireless telecommunication networks. Typical for problems occurring in this context is the simultaneous consideration of continuous optimization variables, e.g., like beamforming vectors and combinatorial aspects, e.g., like the assignment of base stations to mobile users.
Mathematical models are derived that account both for the requirements of the application and the solvability. Usually one has to deal with NP-hard problems in this context that cannot be solved by standard software. We investigate convex approximations as well as heuristics to derive reasonable good solutions. We use these approximations as well as techniques like cutting plane generation aiming to solve the mixed integer nonlinear model of the original problem. The global optimal solution can then also be used to evaluate heuristic and approximation approaches.

Partner: LOEWE Priority Program Cocoon (Cooperative Sensor Communication)

Contact: Anne Philipp, Stefan Ulbrich

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[2] Y. Cheng, A. Philipp, and M. Pesavento. Dynamic rate adaptation and multiuser downlink beamforming using mixed integer conic programming. In *EUSIPCO 2012 - 20th European Signal Processing Conference*, pages 824 – 828, 2012.

Project: Optimal control of switched networks for nonlinear hyperbolic conservation laws

The project is part of the DFG-Priority Program SPP 1253 “Optimization with Partial Differential Equations”.
Its aim is the analysis of optimal control problems for hyperbolic balance laws on networks under modal switching, where the switchings are considered in the source terms as well as at boundary nodes and junctions. This type of problems arise for example in traffic flow models or in models for water and gas networks.
The main difficulty of the analysis of conservation laws stems from the fact that even in the case of a single scalar conservation law and smooth data the entropy solution usually develops shocks, which causes the solution operator not to be differentiable in the usual sense. However, encouraging progress has been achieved recently for the optimal control of conservation laws by using a generalized notion of differentiability (so called shift-differentiability). Switching between different modes may result in additional discontinuities in the solution, which is, however, quite natural in the context of entropy solutions.
The project focuses on the investigation of the existence of optimal controls, the differentiability properties of the reduced objective function w.r.t. the initial and boundary data, the node conditions (at junctions) and switching times as well as the corresponding sensitivity and adjoint equations.

Partner: Günter Leugering, Universität Erlangen-Nürnberg

Support: German Research Foundation (DFG)

Contact: Sebastian Pfaff, Stefan Ulbrich

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[1] M. Giles and S. Ulbrich. Convergence of linearized and adjoint approximations for discontinuous solutions of conservation laws. part 1: Linearized approximations and linearized output functionals. *SIAM J. on Numerical Analysis*, 48(3):882–904, 2010.

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Project: Efficient Numerical Multilevel-Methods for the Optimization of Gas Turbine Combustion Chambers (project D5 of Collaborative Research Centre (SFB) 568)

In the past few years, there has been a lot of development regarding the optimization of flows. This field of research is among the most challenging tasks from a numerical and also theoretical point of view. With todays computational power and algorithmic developments, the optimization of the flow and combustion in a gas turbine chamber is within reach. In this project, we tackle the task of efficient optimization with a sophisticated numerical code for flow solving, while combining them with state of the art optimization techniques.
The basis for the numerical calculations is the parallel multi-grid flow solver FASTEST-3D, which has been developed in the past few years and has various flow and combustions models incorporated.
Via automatic differentiation, we obtain a linear system for the adjoint equations, with which the gradients for the optimization routines are obtained. This has already been done for various kinds of optimization problems including LES and RANS of unsteady three dimensional flows, heat transfer and shape optimization.

For the optimization, a multilevel optimization environment has been implemented. Here, one makes use of a hierarchical order of models describing a problem. Examples for these models are discretization levels or models with increasing physical fidelity.

Partner: Collaborative Research Center (SFB) 568: “Flow and Combustion in Future Gas Turbine Combustion Chambers”; speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Rolf Roth, Stefan Ulbrich

Project: Optimal design and control of adaptronic systems

This project is part of the LOEWE-Center AdRIA, which is a collaborative reserach initiative of the Fraunhofer Institute for Structural Durability and System Reliability LBF, the TU Darmstadt and the Fachhochschule Darmstadt to create a leading international research center for adaptronic systems.
As part of the project "quiet office" we develop cost-effective system solutions to optimize the sound insulation in office buildings to the prototypical market for flat building elements (windows, facades, partition walls), building services (plumbing, heating and air conditioning), and office equipment (projector, printer, copier). The demonstrator "acoustic aquarium" provides an appropriate platform to interpret, implement and evaluate the approaches, methods and solutions for vibration reduction.
An FE model of the acoustic demonstrator was developed and approximated by model order reduction. Based on this model, a method for optimal placement of sensors and actuators is developed. Afterwards we deal with the optimization of controller parameters and the development of linear and nonlinear model predictive control (MPC) algorithms. With the MPC approach, we plan to reduce the noise and vibration by an online optimization method at the acustic demonstrator. The developed methods will be tested and compared with existing methods.

Partner: LOEWE-Center AdRIA: Sven Herold

Contact: Stefan Ulbrich, Carsten Schäfer

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Project: Mathematical Programming in Robust Design (project A3 of Collaborative Research Centre (SFB) 805)

The presence of uncertainty is a prevalent characteristic in mechanical engineering which can lead to severe economical and safety consequences. This applies particularly to fields like lightweight design, e.g. aircraft construction, where high load-bearing capacity has to be combined with low weight and where system failure is not tolerable at any point.
As part of the Collaborative Research Centre (SFB) 805: “Control of uncertainty of load carrying systems in mechanical engineering” we want to find - for load carrying mechanical systems - the optimal robust design regarding uncertainty of parameters, e.g. material properties and loading scenarios, as well as uncertainty of the manufacturing quality.

This is achieved by simulation-based optimization of geometry, topology and the placement of actuators, at which modern techniques of robust optimization are applied and extended. In particular we choose a worst-case approach to incorporate the existing uncertainty into our optimization model. This leads to a computationally intractable problem formulation since we consider nonlinear nonconvex objective functions and further employ complex PDE constraints in order to model the mechanical behaviour of the considered structures. Hence, this so-called robust counterpart is approximated by means of a second order Taylor expansion which is solved by an efficient SQP method.

Partner: Collaborative Research Centre (SFB) 805: "Control of uncertainty of load carrying systems in mechanical engineering"; Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Adrian Sichau, Stefan Ulbrich

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Project: SPEAR – Sparse Exact and Approximate Recovery

The research project "SPEAR – Sparse Exact and Approximate Recovery" deals with the problem to recover a sparse solution of an underdetermined linear (equality) system. This topic has many applications and is a very active research area. It is located at the border between analysis and combinatorial optimization. The main goal of our project is to obtain a better understanding of the conditions under which (efficiently) finding such a sparse solution, i.e., recovery, is possible. Our project is characterized by both theoretical and computational aspects as well as the interplay of continuous and discrete methods.
The SPEAR project is a collaboration of the Research Group Optimization at the TU Darmstadt (since 2012, previously: Institute for Mathematical Optimization at the TU Braunschweig) and the Institute for Analysis and Algebra at the TU Braunschweig. The project is funded by a DFG research grant. Designated project period: 2011–2014.

Partner: Dirk A. Lorenz and Christian Kruschel, TU Braunschweig

Support: German Research Foundation (DFG)

Contact: Marc Pfetsch, Andreas Tillmann

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Project: Mathematical models and algorithms for an automated product development of branched sheet metal products (Subproject A2 of Collaborative Research Centre (SFB) 666)

This project is part of the Collaborative Research Centre (SFB) 666 (Integral sheet metal design with higher order bifurcations - development, production, evaluation) and addresses the shape optimization of sheet metal products. There are two types of considered sheet metal products: Multi-chambered profiles and hydroformed branched sheet metal structures. For profiles, the goal is to find the optimal design of the profile-cross-sections. For this purpose, an integrated approach combining topology and geometry optimization is developed. Using branch and bound techniques, topological decisions are made where in each branch and bound node a nonlinear optimization problem has to be solved. As hydroformed parts can show arbitrary curvature, the geometry of those parts is parameterized by cubic B-spline surfaces. The product behavior is described by the three dimensional linear elasticity equations. To optimize the geometry optimization of the branched and hydroformed sheet metal products, PDE constrained optimization techniques are used. The arising nonconvex geometry optimization problem is solved with an algorithm using exact constraints and a globalization strategy based on adaptive cubic regularization. For decreasing the computational effort multilevel-techniques are applied.

Partner: Collaborative Research Centre (SFB) 666: “Integral sheet metal design with higher order bifurcations - development, production, evaluation”; speaker Prof. Dr.Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Thea Göllner, Hendrik Lüthen, Marc Pfetsch, Stefan Ulbrich

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[3] T. Göllner, W. Hess, and S. Ulbrich. Geometry optimization of branched sheet metal products. *Proceedings in Applied Mathematics and Mechanics*, 12:619 – 620, 2012.

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[5] P. Groche, W. Schmitt, A. Bohn, S. Gramlich, S. Ulbrich, and U. Günther. Integration of manufacturing-induced properties in product design. *Tagungsband 4. Zwischenkolloquium Sonderforschungsbereich 666, Hrsg. Peter Groche*, pages 15 – 24, 2012.

[6] W. Hess and S. Ulbrich. An inexact l1 penalty sqp algorithm for pde constrained optimization with an application to shape optimization in linear elasticity. *Optimization Methods and Software*, pages 1 – 26, 2012.

[7] O. Weitzmann, A. Schüle, T. Rollmann, R. Anderl, and T. Göllner. An object-oriented information model for the representation of free form sheet metal parts in integral style. *Tools and Methods of Competitive Engineering*, pages 725 – 738, 2012.

Project: Simulation-based optimization methods for the hydro-forming of branched structures (Subproject A6 of Collaborative Research Centre (SFB) 666)

This project is part of the Collaborative Research Centre (SFB) 666 (Integral sheet metal design with higher order bifurcations - development, production, evaluation) and is concerned with the optimal control of the sheet metal hydro-forming. The sheet metal hydro-forming process is a complex forming process, which involves contact, friction and plasticity to manufacture complexly curved sheet metals with bifurcated cross-section. Mathematically, this leads to a quasi-variational inequality. We want to find optimal controls for typical control variables, e.g., the time dependent blank holder force and the fluid pressure, by the use of simulation-based optimization methods. Our goal is to obtain a desired final configuration, taking into consideration relevant parameters for the production. On the one hand, we use derivative free optimization methods to solve the optimal control problem, where the commercial FEM-software ABAQUS is invoked for the simulations and, on the other hand, instantaneous optimization methods are under investigation. In this context model reduction techniques, e.g. Proper Orthogonal Decomposition, will be employed to achieve a suboptimal solution for the optimal control problem.

Partner: Collaborative Research Centre (SFB) 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation"; speaker Prof. Dr.Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: Daniela Koller, Stefan Ulbrich

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[1] D. Koller and S. Ulbrich. Optimal control of hydroforming processes. *Proceedings in Applied Mathematics and Mechanics*, 11:795 –796, 2011.

[2] D. Koller and S. Ulbrich. Ableitungsfreie Optimierungsverfahren für die optimale Steuerung von wirkmedienbasierten Tiefziehprozessen. *Tagungsband 4. Zwischenkolloquium Sonderforschungsbereich 666, Hrsg. Peter Groche*, pages 41 – 48, 2012.

2.3 Memberships in Scientific Boards and Committees

Michael Joswig

Scientific Advisory Board: "Oberwolfach References on Mathematical Software"

Marc Pfetsch

Scientific Program Commitee for the CPAIOR 2012 conference, Nantes

Stefan Ulbrich

Scientific Program Commitee for the OMS 2012 conference, Chania

Scientific Program Commitee for the SIAM OP12 conference, Darmstadt

Organizing Commitee for the SIAM OP12 conference, Darmstadt

Organizing Commitee for the GAMM 2012 conference, Darmstadt

Member of the IFIP Technical Committee TC 7, WG 7.2 "Computational Techniques in Distributed Systems", 2003–

Member of GAMM Activity Group “Optimization with PDE constraints”, 2008–

Member of GAMM Activity Group “Computational Science and Engineering”, 2012–

Member of SIAM Activity Group “Optimization”, 2003–

2.4 Awards and Offers

Awards

Sarah Drewes, Ruth-Moufang-Preis (Fachbereich Mathematik, TU Darmstadt), May 25, 2011

Jan Carsten Ziems, Preis für hervorragende wissenschaftliche Leistungen (Vereinigung der Freunde der TU Darmstadt e.V.), April 27, 2012

Offers of Appointments

Michael Joswig, Professor (W3), TU Berlin

Stefan Ulbrich, Professorship (W3) for Algorithmic Optimization, Humboldt-Universität zu Berlin

Irwin Yousept, W2-Professorship (5 years) for Applied Mathematics , RWTH Aachen

4 Publications

4.1 Co-Editors of Publications

4.1.1 Editors of Journals

Michael Joswig

Advances in Geometry (Member of the Editorial Board)

Beiträge zur Algebra und Geometrie (Member of the Editorial Board)

Electronic Geometry Models (Managing Editor)

Stefan Ulbrich

Journal of Optimization Theory and Applications (Associate Editor)

Optimization Methods and Software (Regional Editor Europe)

SIAM Journal on Optimization (Associate Editor)

Asymptotic Analysis (Associate Editor)

4.1.2 Editors of Collected Works

Stefan Ulbrich

Constrained Optimization and Optimal Control for Partial Differential Equations, Birkhäuser Verlag, 2012 (jointly with S. Engell, A. Griewank, M. Hinze, G. Leugering, R. Rannacher, V. Schulz, M. Ulbrich)

4.2 Monographs and Books

[1] M. Joswig and T. Theobald. *Polyhedral and algebraic methods in algorithmic geometry*. Springer, 2013.

[2] U. Lorenz, T. Ederer, C. Juretzka, T. Opfer, M. Utz, and S. Weber. *Maple: Eine Einführung in das Computer-Algebra-System*. RRZN, 2011.

[3] M. Ulbrich and S. Ulbrich. *Nichtlineare Optimierung*. Mathematik Kompakt. Birkhäuser, Basel, 2012.

4.3 Publications in Journals and Proceedings

4.3.1 Journals

[1] E. Abele, M. Haydn, T. Hauer, U. Lorenz, and T. Ederer. Unsicherheitsoptimierte Prozesskette bei der Bohrungsfeinbearbeitung. *wt Werkstatttechnik online*, 101:730–736, 2011.

[2] J. Avemann, S. O. Schmitt, T. Ederer, U. Lorenz, and P. Groche. Analysis of market demand parameters for the evaluation of flexibility in forming technology. *Enabling Manufacturing Competitiveness and Economic Sustainability*, pages 458–463, 2011.

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[5] R. Bödi, K. Herr, and M. Joswig. Algorithms for highly symmetric linear and integer programs. *Math. Programming, Series A*, 137:65–90, 2013.

[6] R. Borndörfer, M. Karbstein, and M. E. Pfetsch. Models for fare planning in public transport. *Discrete Appl. Math.*, 160(18):2591–2605, 2012.

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[8] A. Dochtermann, M. Joswig, and R. Sanyal. Tropical types and associated cellular resolutions. *J. Algebra*, 356:304–324, 2012.

[9] P.-É. Druet, O. Klein, J. Sprekels, F. Tröltzsch, and I. Yousept. Optimal control of three-dimensional state-constrained induction heating problems with nonlocal radiation effects. *SIAM Journal on Control and Optimization*, 49(4):1707–1736, 2011.

[10] P. Groche, H. Birkhofer, O. Bauer, T. Göllner, S. Gramlich, V. Kaune, F. Rullmann, and O. Weitzmann. Potenziale einer durchgängigen Produktentstehung - Nutzung technologieinduzierter Eigenschaften zur Entwicklung von Blechstrukturen. *Konstruktion*, 11/12-2012, 2012.

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[12] P. Groche, W. Schmitt, S. Gramlich, S. Ulbrich, and U. Günther. Integration of manufacturing-induced properties in product design. *CIRP Annals - Manufacturing Technology*, 61:163–166, 2012.

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4.3.2 Proceedings and Chapters in Collections

[1] B. Baumeister, C. Haase, B. Nill, and A. Paffenholz. Permutation polytopes of cyclic groups. In *Proceedings of FPSAC 2012*, pages 421–432. DMTCS, 2012.

[2] C. Brandenburg, F. Lindemann, M. Ulbrich, and S. Ulbrich. Advanced Numerical Methods for PDE Constrained Optimization with Application to Optimal Design in Navier Stokes Flow. In *Constrained Optimization and Optimal Control for Partial Differential Equations*, volume 160 of *Internat. Ser. Numer. Math.*, pages 257–275. Birkhäuser, Basel, 2012.

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4.4 Preprints

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[8] K. Herr, T. Rehn, and A. Schürmann. Exploiting symmetry in integer convex optimization using core points. Preprint, TU Darmstadt, 2012.

[9] S. Horn. A Topological Representation Theorem for tropical oriented matroids: Part I, Dec. 2012. arxiv:1212.0714.

[10] S. Horn. A Topological Representation Theorem for tropical oriented matroids: Part II, Dec. 2012. arxiv:1212.2080.

[11] M. Joswig and G. M. Ziegler. Foldable triangulations of lattice polygons. arXiv:1207.6865.

[12] D. A. Lorenz, M. E. Pfetsch, and A. M. Tillmann. An infeasible-point subgradient method using adaptive approximate projections. Preprint, TU Darmstadt, TU Braunschweig, 2012.

[13] D. A. Lorenz, M. E. Pfetsch, and A. M. Tillmann. Solving basis pursuit: Subgradient algorithm, heuristic optimality check, and solver comparison. Preprint, TU Darmstadt, TU Braunschweig, 2012.

[14] B. Nill and A. Paffenholz. On the equality case in ehrhart's volume conjecture, May 2012. arxiv:1205.1270.

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[16] M. E. Pfetsch and A. M. Tillmann. The computational complexity of the restricted isometry property, the nullspace property, and related concepts in compressed sensing. Preprint, TU Darmstadt, 2012.

[17] A. Schiela and S. Ulbrich. Operator preconditioning for a class of constrained optimal control problems. Preprint, submitted, TU Darmstadt, 2012.

[18] J. C. Ziems. Adaptive Multilevel Inexact SQP-Methods for PDE-constrained Optimization with Control Constraints. Preprint, TU Darmstadt, 2011.

[19] J. C. Ziems and S. Ulbrich. Adaptive Multilevel Generalized SQP-Methods for PDE-constrained Optimization. Preprint, TU Darmstadt, 2011.

4.5 Reviewing and Refereeing

4.5.1 Reviewing

Michael Joswig: Zentralblatt

Ulf Lorenz: Mathematical Reviews

Irwin Yousept: Mathematical Reviews

4.5.2 Refereeing

Michael Joswig: International J. Combin., J. Combin. Th. (Series A), European J. Combin., J. Algebra, Discrete Comput. Geometry, J. Alg. Combin., Linear Algebra Appl., Computational Geometry: Theory and Application, Journal of Mathematics, Math. of Computation, An. Stiint. Univ. Ovidius Ser. Mat., FPSAC 2011, EUROCOMB11

Ulf Lorenz: Theoretical Computer Science (TCS), Advances in Computers and Games (ACG), European Symposium on Algorithms (ESA), Parallel Processing Letters, Transactions on Computational Intelligence and AI in Games, International Conference on Uncertainty in Mechanical Engineering, International Journal of Computer Games, DFG, NWO

Andreas Paffenholz: Journal of Combinatorial Theory A, Journal of Algebraic Combinatorics, International Mathematical Research Notices

Marc Pfetsch: CPAIOR 2012, Discrete Applied Mathematics, European Journal of Operations Research, Journal of Symbolic Computation, Mathematical Programming Computation, Networks, OR Letters

Stefan Ulbrich: Computational Optimization and Applications, Inverse Problems, Mathematical Programming, Mathematics of Computation, Optimization and Engineering, Optimization Methods & Software, SIAM Journal on Control and Optimization, SIAM Journal on Optimization, SIAM Journal on Scientific Computing

Irwin Yousept: Computational Optimization and Applications (COAP), Journal of Optimization Theory and Applications (JOTA), Mathematical Methods in the Applied Sciences, Systems and Control Letters, Mathematical and Computer Modelling of Dynamical Systems, Acta Applicandae Mathematicae

4.6 Software

polymake: *Software for Geometric Combinatorics*
polymake started out as a tool for the algorithmic treatment of convex polyhedra. By now it also deals with toric varieties, tropical polytopes, and other objects. The software is jointly developed by the polymake team, lead by Ewgenij Gawrilow (TomTom) and Michael Joswig. For more information, see `www.polymake.org`

Contributors at TU Darmstadt: Benjamin Assarf, Roberto Henschel, Katrin Herr, Silke Horn, Michael Joswig, Katja Kulas, Andreas Paffenholz, Benjamin Schröter

SDP Package for SCIP: *Solving MISDPs using SCIP*
The SDP Package is a plug-in for the branch-and-bound framework SCIP for solving general MISDPs, see `www.opt.tu-darmstadt.de/~smars/scip_sdp.html`.

Contributor at TU Darmstadt: Sonja Mars

SCIP: *Software for Solving Constraint Integer Programs*
SCIP is a framework for solving constraint integer programs and performing branch-cut-and-price. It allows total control of the solution process and the access of detailed information. SCIP is also currently one of the fastest non-commercial mixed integer programming (MIP) solvers. It is developed together with the Zuse Insitute Berlin and the University of Erlangen-Nürnberg. For more information, see `scip.zib.de`

Contributor at TU Darmstadt: Marc Pfetsch

ISAL1: *Infeasible-Point Subgradient Algorithm for Basis Pursuit*
ISAL1 is a subgradient algorithm employing adaptive approximate projections for solving the basis pursuit problem, i.e., finding a minimum-l1-norm solution to an underdetermined linear equation system. For more information, see `http://wwwopt.mathematik.tu-darmstadt.de/spear/`

Contributor at TU Darmstadt: Andreas M. Tillmann

L1-Testset: *A set of test instances for L1-Minimization*
L1-Testset consists of 548 basis pursuit instances consisting of the constraint data (matrix and right hand side vector), a known unique optimal solution, and various data-specific parameters, constructed for the purpose of a unified solver comparison for basis pursuit problems. For more information, see `http://wwwopt.mathematik.tu-darmstadt.de/spear/`

Contributor at TU Darmstadt: Andreas M. Tillmann

ipfilter: *An NLP Solver based on a primal-dual interior-point filter algorithm*
ipfilter is a state-of-the-art solver for nonlinear programming problems (defined by the minimization of an objective function in a feasible region defined by equality and inequality constraints).
See `http://www.mat.uc.pt/ipfilter/`

Contributor at TU Darmstadt: Stefan Ulbrich

5 Theses

5.2 PhD Dissertations

2011

Brandenburg, Christian, *Adjoint-Based Adaptive Multilevel Shape Optimization based on Goal-Oriented Error Estimators for the Instationary Navier-Stokes Equations* (Stefan Ulbrich)

Heidrich, Matthias, *Conditional Value-at-Risk Optimization for Credit Risk Using Asset Value Models* (Stefan Ulbrich)

2012

Horn, Silke, *Tropical Oriented Matroids and Cubical Complexes* (Michael Joswig)

Kulas, Katja, *Combinatorics of Tropical Polytopes* (Michael Joswig)

Roth, Rolf, *Multilevel Optimization of Turbulent Flows by Discrete Adjoint Techniques* (Stefan Ulbrich)

5.3 Diplom Theses

2011

Aronava, Lina, *Robuste Portfolio-Optimierung basierend auf gemeinsam ellipsoiden Unsicherheitsmengen* (Stefan Ulbrich)

Assarf, Benjamin, *Auswirkungen von Gaps im Sequence Alignment Problem auf Tightspans* (Michael Joswig)

Ayat, Abdelhamid, *The implementation of algorithms for parameter estimation and optimal experimental design using Matlab and Chebfun* (Stefan Ulbrich)

Bednarek, Marei, *Gültige Ungleichungen aus mehreren Zeilen des Simplextableaus* (Marco Lübbecke)

Betz, Thomas, *Optimale Steuerung elastoplastischer Verformungsprozesse* (Christian Meyer)

Brandau, Roland, *Integriertes Modell der Profiloptimierung zur Herstellung von Mehrkammerprofilen* (Stefan Ulbrich)

Caspar, Roland, *Auffalten von orthogonalen Bäumen* (Alexander Martin)

Funk, Katharina, *Verschiedene Ansätze zur mathematischen Optimierung von Wasserversorgungsnetzen* (Ulf Lorenz)

Hartmann, Benjamin, *Erzeugung von 3-dimensionalen Polytypen und Triangulierungen durch Projektion höher dimensionaler Polytypklassen* (Michael Joswig)

Keim, Oliver, *Incorporating Convex Hulls into an Algorithmic Approach for Territory Design Problems* (Alexander Martin)

Lehmann, Nora, *Optimierung der Baustellenplanung im Schienenverkehr* (Marco Lübbecke)

Markert, Melanie Heidrun, *Robuste Optimierung aktiver Stabwerke mittels polyedrisch-elliptischen Unsicherheitsmengen sowie nichtlinearer Semidefinierter Programmierung* (Stefan Ulbrich)

Meinlschmidt, Hannes, *Optimal control of the thermistor problem* (Robert Haller-Dintelmann / Christian Meyer)

Muth, Sebastian, *Topologieabhängige robuste Optimierung aktiver Stabwerke mittels MISDP* (Stefan Ulbrich)

Nagel, Markus, *Das Transmission Line Problem aus Sicht der Diskreten Optimierung* (Ulf Lorenz / Martin Ziegler)

Opfer, Thomas, *Entwicklung eins exakten rationalen dualen Simplex-Lösers* (Martin Ziegler / Ulf Lorenz)

Philipp, Anne, *Anwendung von Verfahren der Nichtlinearen Semidefiniten Programmierung auf die Robuste Optimierung von aktiven Stabwerken* (Stefan Ulbrich)

Rauch, Bernhard, *Solving indefinite quadratic problems by combining QP-convexification techniques with a new interior-point-based primal heuristic* (Stefan Ulbrich)

Roth, Martina, *Demand and Capacity Balancing – Ein Modell zur flugbasierten Komplexitätsbetrachtung* (Stefan Ulbrich)

Rozenberg, Dimitri, *Robuste Conditional Value-at-Risk Portfoliooptimierung* (Stefan Ulbrich)

Schad, Adrian, *Solutions to the Broadcasting Problem* (Stefan Ulbrich)

Schäfer, Carsten, *Modell-prädikative Regelung zur aktiven Dämpfung von elastischen Systemen* (Stefan Ulbrich)

Schermuly, Claudia, *Modellierung und Anwendung zur Dekomposition von Graphen* (Michael Joswig)

Schulze, Moritz, *Expanding Branch and Bound for binary integer programs with a pseudo-boolean solver and a SAT based presolver* (Alexander Martin)

Seeger, Jens, *Geometrieoptimierung verzweigter Blechbauteile* (Stefan Ulbrich)

Siagam, Eric Salvador, *Robust Portfolio Optimization: A Conic Programming Approach* (Stefan Ulbrich)

Steigerwald, Martin Josef, *Planung von gekoppelten Strom-, Gas- und Wärmenetzen* (Alexander Martin)

Tischhauser, Gundula Elfi, *Modellierung und Simulation von Netzwerken hyperbolischer Erhaltungsgleichungen* (Stefan Ulbrich)

Wagner, Tobias, *Integriertes Modell und Algorithmus der Profiloptimierung zur Herstellung von Mehrkammerprofilen* (Stefan Ulbrich)

Weider, Katrin, *Die Anwendung der Topologischen Ableitung in der Strukturoptimierung* (Stefan Ulbrich)

Wojciechowski, Philipp, *Generalisierte Multilevel SQP-Methoden für PDE-beschränkte Optimierung mit Modellen reduzierter Ordnung* (Stefan Ulbrich)

Zeng, Dequan, *Linear Model-Predictive Control of Cooperative Multi-Vehicle for Time-Dependent* (Oskar von Stryk / Stefan Ulbrich)

2012

Bott, Stefanie, *Adaptive Multilevel SQP-Verfahren für zustandsrestringierte Optimierung mit partiellen Differentialgleichungen* (Stefan Ulbrich)

Brückmann, Volker, *MINLP zur Topologieoptimierung verzweigter Kohlenstoffnanoröhrchen – Modellierung, Implementierung mit GAMS und Berechnung* (Jens Wackerfuß / Stefan Ulbrich)

Do, Phuong Thao, *Robuste Portfolio-Optimierung mit Value-at-Risk als Risikomaß* (Stefan Ulbrich)

Fischer, Tobias, *Konstruktion von dünn besetzten Sensing Matrizen* (Marc Pfetsch)

Geier, Sascha, *Multilevel Monte Carlo Methoden in der stochastischen Optimierung mit Anwendung auf High Frequency Trading* (Stefan Ulbrich)

Jakob, Manuel, *Methodology for Site Selection for Route-Based Traffic Network Optimizations and Relative Costs of Implementation: Numerical Studies* (Alexandre Bayen (Berkeley), Stefan Ulbrich)

Kaier, Anton, *Kalibrierung der Quelle-Ziel-Nachfragematrix auf Basis von Querschnittszähldaten im Öffentlichen Verkehr* (Stefan Ulbrich)

Kohlleppel, Laura, *Myopisches Verhalten und Karriereanreize* (Volker Nitsch / Stefan Ulbrich)

Kresse, Björn, *Optimale Steuerung von hyperbolischen Erhaltungsgleichungen auf Netzwerken* (Stefan Ulbrich)

Kriha, Nils, *Parallelisierung in der algorithmischen Geometrie* (Michael Joswig)

Macht, Christina, *Regularisation of the Problem of Static Elastoplasticity with Kinematic Hardening* (Christian Meyer / Stefan Ulbrich)

Pesch, Joana, *Ein Algorithmus für kardinalitätsbeschränkte quadratische Optimierungsprobleme mit Anwendung auf die Portfoliooptimierung* (Stefan Ulbrich)

Schüssler, Daniel, *Algorithmische Bestimmung der Haken-Eigenschaft bei 3-Mannigfaltigkeiten* (Michael Joswig)

5.4 Master Theses

2011

Chakarova, Elica Emilova, *Eine Heuristik zur Unterstützung der Ladeplanung bei Fluggesellschaften am Beispiel der Lufthansa Cargo AG* (Marco Lübbecke)

Chakoute Mepipyou, Aristide Briand, *Optimale Steuerung auf einem Strassennetzwerk* (Stefan Ulbrich)

Horcicka, Michael, *Anwendung der Theorie und Verfahren der nichtlinearen Optimierung in der Teilchentherapie* (Christian Meyer)

Winter, Bianca, *Mathematische Optimierungsmethoden für die Konferenzplanung* (Ralf Borndörfer)

2012

Lippert, Roman, *Untersuchung des "Recoverable Robustness" Konzepts zur Bewältigung von Unsicherheiten in Fahrplänen des Schienenverkehrs* (Malte Fliedner / Stefan Ulbrich)

Lohfert, Jan-Hendrik, *Diversifikationseffekte in Asset Allocation, Kapitalallokation und Risikotragfähigkeitsanalyse: MaRisk-konforme Modelle und empirische Fundierung* (Stefan Ulbrich)

Vock, Sebastian Erik, *Analyse der Abhängigkeiten zwischen Key Performance Areas und Key Performance Indicators* (Stefan Ulbrich)

5.5 Bachelor Theses

2011

Barbehön, Janine, *Optimierung von Materialströmen* (Ulf Lorenz)

Bauer, Rachel, *Optimierung dreidimensionaler Spaltprofile* (Stefan Ulbrich)

Biehl, Johanna, *Modellierung des Dynamic Graph Reliability Problems und Lösungsansätze* (Ulf Lorenz)

Burkhardt, Sina, *Ein Branch-and-Price-Algorithmus für Graphenfärbung* (Marco Lübbecke)

Mack, Julia Katharina, *Negative Kreise in gerichteten Graphen und konvexe Hüllen* (Michael Joswig)

Neis, Ilona, *Optimierung spaltprofilierter Blechprofile hinsichtlich thermodynamischer Eigenschaften* (Stefan Ulbrich)

Niel, Lisa Jannic, *Finite Elemente Theorie für lineare elliptische partielle Differentialgleichungen* (Christian Meyer)

Petermann-Habich, Tina, *Entfaltung 3-dimensionaler Polytope* (Michael Joswig)

Rausch, Lea, *Input-Optimierung eines hashbasierten Signaturverfahrens* (Ulf Lorenz)

Reiser, Thomas, *Optimierte Produktionsplanung für einen Stabwerkdemonstrator* (Ulf Lorenz)

Schmitt, Michael Johann, *Anwendungen der Second-Order Cone Programmierung* (Stefan Ulbrich)

Stahl, Sebastian, *Randomisierte Pivotstrategien auf einfachen Polytopen* (Michael Joswig)

Stinson, Felix, *Robuste Portfoliooptimierung mit Conditional-Value-at-Rok als Risikomaß* (Stefan Ulbrich)

Utz, Marlene Luka, *Optimierung in einem virtuellen Warmwalzwerk auf der Simulationsplattform TOPSU* (Ulf Lorenz)

Walter, Philipp, *Gemischt-ganzzahlige Optimierung am Beispiel von Losgrößenproblemen* (Marco Lübbecke)

2012

Bergner, Arnold, *Homotopy method for ℓ_1-minimization* (Marc Pfetsch)

Christoffer, Frauke, *Polytope aus Teilgraphen mit Fokus auf serien-parallelen Graphen* (Michael Joswig)

Diehl, Jasmin, *Polytope aus Teilgraphen mit Fokus auf vollständig bipartite Graphen* (Michael Joswig)

Grabiec, Anna, *Ein Strukturorientierter Vorwärtsmodus des Automatischen Differenzierens und dessen Implementierung im MATLAB* (Stefan Ulbrich)

Hameister, Martin, *Standortoptimierung unter Unsicherheit* (Ulf Lorenz)

Isufaj, Fatima, *Das Polyeder der negativen Flüsse* (Michael Joswig)

Knobloch, Eduard, *Die Zhang und Donoho Kriterien zur Rekonstruktion via ℓ_1-Minimierung* (Marc Pfetsch)

Nowak, Daniel, *Integrierte Klassifikation von Hyperebenen und Merkmal-Auswahl* (Marc Pfetsch)

Orlova-Klug, Elena, *Anwendung von Szenarioreduktion auf RQLP´s* (Ulf Lorenz)

Ristl, Konstantin, *Optimierung des Conditional Value-at-Risk von Portfolios mit diskreten Gewichten* (Stefan Ulbrich)

Salupo, Giuseppe, *Robuste Portfolio-Optimierung mit Conditional Value-at-Risk als Risikomaß* (Stefan Ulbrich)

Weyer, Jonas Helmut, *Ein neues Relaxationsschema zur numerischen Lösung von MPECs* (Stefan Ulbrich)

6 Presentations

6.1 Talks and Visits

6.1.1 Invited Talks and Addresses

Sarah Drewes

04/07/2011 *Exploiting structure in outer approximation based approaches for SOCP*
Algebra and Discrete Mathematics Seminar, University of California, Davis, USA

04/14/2011 *Methods to solve Mixed Integer Second Order Cone Programming Problems*
Industrial Engineering and Operations Research Seminar, University of California, Berkeley, USA

05/17/2011 *Maximizing expected utility in the presence of discrete decisions*
SIAM Conference on Optimization 2011, Darmstadt

06/20/2011 *Cover Inequalities for Mixed-01 Nonlinear Programming*
Mixed Integer Programming Workshop 2011, Waterloo, Canada

Jane Ghiglieri

07/04/2011 *Optimale Strömungskontrolle mit Plasmaaktuatoren*
Oberseminar Numerische Mathematik, Optimierung und Dynamische Systeme, Universität Bayreuth

04/13/2012 *Optimale Strömungskontrolle basierend auf MPC und POD zur Auslöschung von Tollmien-Schlichting Wellen mit Plasma Aktuatoren*
Institut für Strömungsmechanik, TU Dresden

Kai Habermehl

08/23/2012 *Robust design of active trusses via mixed integer nonlinear semidefinite programming*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Katrin Herr

10/28/2011 *Core sets and symmetric fibrations*
Workshop on Polyhedra, Symmetry, and Optimization, Universität Rostock

Imke Joormann

03/05/2012 *Analyzing conflicts in natural gas networks*
International Conference on High Performance Scientific Computing 2012, Hanoi, Vietnam

08/22/2012 *Analyzing infeasibilities in natural gas networks*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Michael Joswig

02/08/2011 *Computing bounded subcomplexes of unbounded polyhedra*
Workshop: Topological and Geometric Combinatorics, Oberwolfach

04/08/2011 *Tropical hyperplane arrangements and associated monomial ideals*
Kolloquium, Universität Osnabrück

06/28/2011 *Dressians and their rays*
Conference on "Tropical Geometry", University of Birmingham, England

09/02/2011 *Highly symmetric integer linear programs*
University of California, Davis, USA

09/14/2011 *Splitting polytopes*
San Francisco State University, USA

10/06/2011 *Splitting polytopes*
University of California, Los Angeles, USA

10/24/2011 *Totally splittable polytopes*
ERC Workshop, FU Berlin

12/14/2011 *Dressians, tropical Grassmannians, and their rays*
CIEM, Castro Urdiales, Spain

04/02/2012 *Tropical convexity and type ideals*
ICMS Edinburgh, Scotland

04/30/2012 *Triangulations of products of simplices with a view towards tropical geometry*
Workshop: Triangulations, Oberwolfach

06/19/2012 *An introduction to `polymake` 2.12*
Minisymposium on Publicly Available Geometric/Topological Software, University of North Carolina, Chapel Hill, USA

11/20/2012 *Lattice polygons and real roots*
University of Queensland, Brisbane, Australia

11/30/2012 *Tropical combinatorics*
University of Sydney, Australia

12/13/2012 *`polymake` for high-dimensional computational geometry*
CGL Review Meeting, Berlin

Silke Horn

05/16/2012 *Topological Representations of Tropical Oriented Matroids*
Combinatorics Seminar, Aalto University, Finland

06/06/2012 *A Topological Representation Theorem for Tropical Oriented Matroids*
Combinatorics Seminar, Universität Bremen

09/17/2012 *Tropical Oriented Matroids*
Annual Meeting of the DMV, Universität des Saarlandes, Saarbrücken

Sonja Mars

08/23/2012 *Approaches to solve mixed-integer semidefinite programmes*
International Symposion on Mathematical Programming (ISMP) 2012, Berlin

10/09/2012 *Using SCIP to solve mixed-integer semidefinite programmes*
SCIP Workshop 2012, Darmstadt

Andreas Paffenholz

06/14/2011 *Exploring Geometry with* `polymake`
San Francisco State University, USA

09/20/2011 *Permutation Polytopes*
DMV-Tagung 2011, Köln

11/30/2011 *Permutation Polytopes*
Oberseminar AG Diskrete Mathematik, Universität Frankfurt

12/05/2011 *Permutation Polytopes*
Oberseminar AG Gruppen und Geometrie, Universität Bielefeld

08/24/2012 *Permutation, Marginal, and Cut Polytopes*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

12/15/2012 *Polyhedral Adjunction Theory*
Computational Geometry Seminar, University of Sydney, Australia

12/18/2012 *Structure and Classifications of Fano Polytopes*
Oberseminar AG Algebra und Geometrie, Universität Magdeburg

Marc Pfetsch

12/11/2012 *Computational Solver Comparison for Basis Pursuit*
Workshop "Sparse Representation of Functions: Analytic and Computational Aspects", Berlin

12/03/2012 *Coloring and Symmetries*
Mathematical Colloquium, Universität Paderborn

11/30/2012 *Compressed Sensing and Discrete Optimization*
Colloquium, Liège, Belgium

08/24/2012 *A computational comparison of symmetry handling methods in integer programming*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

07/11/2012 *Compressed Sensing und Diskrete Optimierung*
Inaugural lecture, TU Darmstadt

05/16/2012 *Compressed Sensing and Discrete Optimization*
Seminar Working Group Discrete Mathematics, Goethe Universität Frankfurt

Adrian Sichau

11/14/2011 *A Second Order Approximation Technique for Robust Shape Optimization*
1st International Conference on Uncertainty in Mechanical Engineering (ICUME), Darmstadt

Andreas M. Tillmann

08/21/2012 *Heuristic optimality check and computational solver comparison for basis pursuit*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

12/12/2012 *Branch & Cut for ℓ_0-Minimization*
Workshop "Sparse Representation of Functions: Analytic and Computational Aspects", TU Berlin

Stefan Ulbrich

03/17/2011 *Optimal Control of Discontinuous Solutions of Hyperbolic Conservation Laws*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal, Austria

05/16/2011 *Numerical Approximation of Optimal Control Problems for Discontinuous Solutions of Hyperbolic Conservation Laws*
SIAM Conference on Optimization 2011, Darmstadt

07/14/2011 *Adaptive Multilevel Methods for PDE-Constrained Optimization Based on Adaptive Finite Element or Reduced Order Approximations*
AC.CES 2011, RWTH Aachen

07/20/2011 *Optimal Control of Discontinuous Solutions of Hyperbolic Conservation Laws: Theory and Numerical Approximation*
9th Meeting on Hyperbolic Conservation Laws, Fluid Dynamics and Transport Equations, SISSA-ISAS, Trieste, Italy

09/15/2011 *Numerical Approximation of Optimal Control Problems for Discontinuous Solutions of Hyperbolic Conservation Laws*
IFIP TC 7 Conference on System Modeling and Optimization 2011, Berlin

09/28/2011 *Optimal Control of Discontinuous Solutions of Hyperbolic Conservation Laws: Theory and Numerical Approximation*
ESF Waves Workshop 2011, Würzburg

10/13/2011 *Adaptive Multilevel Methods for PDE-Constrained Optimization Based on Adaptive Finite Element or Reduced Order Approximations*
International Workshop on Control and Optimization of PDEs, Graz, Austria

11/07/2011 *Adaptive Multilevel Methods for PDE-Constrained Optimization Based on Adaptive Finite Element or Reduced Order Approximations*
Seminar of the IANS, Universität Stuttgart

12/02/2011 *Numerical Approximation of Optimal Control Problems for Discontinuous Solutions of Hyperbolic Conservation Laws*
Workshop on Optimal Control of PDEs, Klaffenbach

02/03/2012 *Adaptive Multilevel Methods for PDE-Constrained Optimization Based on Adaptive Finite Element or Reduced Order Approximations*
18. Treffen Rhein-Main-Arbeitskreis Mathematics of Computation, Darmstadt

02/12/2012 *Multilevel Preconditioner for Contact Problems and Optimal Control*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal, Austria

03/19/2012 *Multilevel Methods for PDE-Constrained Optimization involving Adaptive Discretizations and Reduced Order Models*
Colloquium, CAAM Department, Rice University, Houston, USA

05/16/2012 *Multilevel Methods for PDE-Constrained Optimization involving Adaptive Discretizations and Reduced Order Models*
Conference on Optimization Methods and Software 2012, Chania, Greece

08/21/2012 *Multilevel Optimization based on Adaptive Discretizations and Reduced Order Models for Engineering Applications*
International Symposium on Mathematical Programming (ISMP 2012), Berlin

12/21/2012 *Optimization of deep drawing processes*
Workshop on Complementarity and its Extensions, Institute for Mathematical Sciences, National University of Singapore

Jan Wolf

08/23/2012 *Accelerating Nested Benders Decomposition with Game Tree Search Techniques to solve Quantified Linear Programs*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Irwin Yousept

05/11/2011 *Optimal control of Maxwell's equations with H(div)-controls and state constraints*
Colloquium, Humboldt-Universität Berlin

07/07/2011 *Optimal control of Maxwell's equations and its applications*
Colloquium, RWTH Aachen

07/21/2011 *Optimal control of 3D induction heating*
International Congress on Industrial and Applied Mathematics (ICIAM), Vancouver, Canada

09/16/2011 *Control of Maxwell's equations*
IFIP TC 7 Conference on System Modeling and Optimization 2011, Berlin

10/26/2011 *Optimal control of Maxwell's equations and its applications*
Colloquium, TU Darmstadt

10/31/2011 *Optimal control in electromagnetic processes*
Colloquium, TU Berlin

11/29/2011 *Optimal control of Maxwell's equations*
Workshop on Optimal Control of Partial Differential Equations, Klaffenbach

12/19/2011 *Optimization of Maxwell's system*
MATHEON Workshop (application area C), TU Berlin

03/19/2012 *PDE-constrained optimizatin in electromagnetic problems*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

08/21/2012 *PDE-constrained optimization involving eddy current equations*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

10/04/2012 *Numerical aspects of optimal control problems of electromagnetic phenomena*
DK Seminar, Strobl, Austria

Jan Carsten Ziems

05/19/2011 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
SIAM Conference on Optimization 2011, Darmstadt

07/27/2011 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
Oberseminar Numerik, Universität Konstanz

09/13/2011 *Multilevel optimization with reduced order models for PDE-constrained problems*
IFIP TC07 Conference on System Modeling and Optimization 2011, Berlin

12/01/2011 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
Workshop on Optimal Control of Partial Differential Equations (in honor of Fredi Tröltzsch's 60th birthday), Chemnitz

03/05/2012 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
International Conference on High Performance Scientific Computing (HPSC) 2012, Hanoi, Vietnam

03/27/2012 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

05/10/2012 *Adaptive multilevel SQP-Methods for Optimization with PDEs*
Collatz-Kolloquium für angewandte Mathematik der Universität Hamburg

6.1.2 Contributed Talks

Benjamin Assarf

11/13/2012 *On the classification of simplicial, terminal, and reflexive polytopes with many vertices*
Optimization Seminar, TU Darmstadt

Stefanie Bott

09/29/2012 *Multilevel Methods with POD for PDE-constrained Optimization with State Constraints*
GSC Retreat, Heppenheim

11/19/2012 *Adaptive Multilevel SQP Method for State Constrained Optimization with PDEs*
Optimization Seminar, TU Darmstadt

12/13/2012 *Adaptive Multilevel SQP Method for State Constrained Optimization with PDEs*
Veszprém Optimization Conference: Advanced Algorithms (VOCAL) 2012, Veszprém, Hungary

Christian Brandenburg

05/23/2011 *Shape Optimization for the Navier-Stokes Equations*
International Conference on Finite Elements in Flow Problems (FEF) 2011

07/05/2011 *Existence- and Differentiability Results for Shape Optimization Problems*
IRTG 1529 Klausurtagung, Heppenheim

Carsten Schäfer

11/26/2012 *Optimization of Adaptronic Systems*
Optimization Seminar, TU Darmstadt

12/13/2012 *Optimization of Adaptronic Systems*
Veszprém Optimization Conference: Advanced Algorithms (VOCAL) 2012, Veszprém, Hungary

Jane Ghiglieri

04/20/2011 *Optimal Flow Control Based on POD for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2011, Graz, Austria

05/17/2011 *Optimal Flow Control based on POD for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
SIAM Conference on Optimization 2011, Darmstadt

09/12/2011 *Optimal Flow Control based on POD for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
IFIP TC 7 Conference on System Modeling and Optimization 2011, Berlin

10/06/2011 *Optimal Flow Control Based on POD for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
International Conference on Computational Engineering, Darmstadt

02/12/2012 *Optimale Strömungskontrolle mit POD und MPC zur Auslöschung von Tollmien-Schlichting Wellen mit Plasma-Aktuatoren*
Chemnitzer Seminar zur Optimalsteuerung 2012, Haus im Ennstal, Austria

05/16/2012 *Optimal Flow Control Based on POD and MPC for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
Conference on Optimization Methods and Software 2012, Chania, Greece

08/24/2012 *Optimal Flow Control Based on POD and MPC for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Thea Göllner

05/16/2011 *Geometry Optimization of Branched Sheet Metal Products*
Poster Session at SIAM Conference on Optimization 2011, Darmstadt

07/04/2011 *Geometrieoptimierung flächiger und verzweigter Blechbauteile*
Optimization Seminar, TU Darmstadt

03/27/2012 *Geometry Optimization of Branched Sheet Metal Products*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

08/22/2012 *Geometry Optimization of Branched Sheet Metal Products*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Kai Habermehl

05/16/2011 *Robust optimization of active trusses via Mixed Integer Semidefinite Programming*
SIAM Conference on Optimization 2011, Darmstadt

02/27/2012 *Control of uncertainties within an interdisciplinary design approach of a robust high heel*
Uncertainties 2012, Maresias, Brazil

03/28/2012 *Robust optimization of active trusses via Mixed Integer Semidefinite Programming*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

Roberto Henschel

11/06/2012 *Eine Verbindung des Chromatischen Polynoms zur Geometrie*
Optimization Seminar, TU Darmstadt

Katrin Herr

05/17/2011 *Solving Highly Symmetric Integer Linear Programs*
SIAM Conference on Optimization 2011, Darmstadt

07/11/2011 *Solving highly symmetric integer linear programs*
Optimization Seminar, TU Darmstadt

Silke Horn

11/11/2011 *A Topological Representation Theorem for Tropical Oriented Matroids*
Kolloquium über Kombinatorik, Universität Magdeburg

11/13/2011 *Two Topological Representation Theorems for Tropical Oriented Matroids*
Optimization Seminar, TU Darmstadt

12/13/2011 *Tropical Oriented Matroids*
Research Seminar, TU Braunschweig

08/02/2012 *A Topological Representation Theorem for Tropical Oriented Matroids*
The 24th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC), Nagoya University, Japan

Daniela Koller

03/17/2011 *Optimale Steuerung wirkmedienbasierter Tiefziehprozesse*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal, Austria

04/21/2011 *Optimal control of hydroforming processes*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2011, Graz, Austria

05/02/2011 *Optimale Steuerung wirkmedienbasierter Tiefziehprozesse*
Optimization Seminar, TU Darmstadt

05/18/2011 *Optimal control of hydroforming processes*
SIAM Conference on Optimization 2011, Darmstadt

02/14/2012 *Optimal Control of hydroforming processes*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal, Austria

03/27/2012 *Optimal control of hydroforming processes*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

08/24/2012 *Optimal control of hydroforming processes based on POD*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

11/14/2012 *Flächige Bauteile mit verzweigtem Querschnitt durch integrierte Spaltbiegeprozesse, HSC-Fräsprozesse und Tiefziehprozesse*
8. Fachtagung Walzprofilieren und 4. Zwischenkolloquium SFB 666, Darmstadt

Sonja Mars

05/18/2011 *Actuator positioning in Truss Topology Design*
SIAM Conference on Optimization 2011, Darmstadt

08/31/2011 *Optimal positioning of active components in trusses under multiple loads*
International Conference on Operations Research (OR) 2011, Zürich, Switzerland

Hannes Meinlschmidt

06/05/2012 *Geometric Theory of Semilinear Problems*
Final workshop on the 15th Internet Seminar on Evolution Equations, Blaubeuren

Andreas Paffenholz

06/09/2011 *Defect Polytopes and Counter-Examples with* `polymake`
ISSAC 2011, San José, USA

11/28/2011 *Permutation Polytopes*
Workshop "Polyhedra, Symmetry and Optimization", Rostock

02/21/2012 *Defect Polytopes and Dual Defective Toric Varieties*
Workshop "Emerging Developments in Real Algebraic Geometry", Magdeburg

02/28/2012 *Polyhedral Adjunction Theory*
Annual Meeting of SPP 1489, Hannover

05/11/2012 *Construction of examples for Kähler-Einstein toric Fano manifolds with* `polymake`
Symposium der Fachgruppe Computeralgebra, Kassel

Sebastian Pfaff

09/26/2011 *Optimal control of switched networks for nonlinear hyperbolic conservation laws*
Annual Meeting of DFG-SPP 1253, Kloster Banz

01/30/2012 *Initial-Boundary-Value-Problems for Hyperbolic Conservation Laws*
Optimization Seminar, Darmstadt

05/14/2012 *Optimal Boundary Control for Nonlinear Hyperbolic Conservation Laws with Source Terms*
Conference on Optimization Methods and Software 2012, Chania, Greece

06/25/2012 *Optimal Boundary Control for Nonlinear Hyperbolic Balance Laws*
International Conference on Hyperbolic Problems 2012, Padua, Italy

08/24/2012 *Optimal Boundary Control for Nonlinear Hyperbolic Conservation Laws with Source Terms*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Marc Pfetsch

03/05/2012 *The Maximum k-Colorable Subgraph Problem and Symmetry*
International Conference on High Performance Scientific Computing (HPSC) 2012, Hanoi, Vietnam

Rolf Roth

03/17/2011 *Multilevel optimization applied in flow control*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal, Austria

05/17/2011 *Multilevel optimization for flow control with discrete adjoints*
SIAM Conference on Optimization 2011, Darmstadt

09/12/2011 *Multilevel optimization for flow control with discrete adjoints*
IFIP TC07 Conference on System Modeling and Optimization 2011, Berlin

11/03/2011 *Multilevel optimization for flow control with discrete adjoints*
Final Colloquium of the Collaborative Research Center (SFB) 568, Seeheim-Jugenheim

Adrian Sichau

05/18/2011 *A Second Order Approximation Technique for Robust Shape Optimization*
SIAM Conference on Optimization, Darmstadt

03/27/2012 *A Second Order Approximation Technique for Robust Shape Optimization*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2012, Darmstadt

08/22/2012 *Shape optimization under uncertainty employing a second order approximation for the robust counterpart*
International Symposium on Mathematical Programming (ISMP) 2012, Berlin

Jan Wolf

09/06/2011 *Quantified Linear Programs: A Computational Study*
European Symposium on Algorithms 2011, Saarbrücken

Jan Carsten Ziems

09/26/2011 *Adaptive multilevel optimization with reduced order models for PDE-constrained problems*
Annual Meeting of DFG-SPP 1253, Kloster Banz

6.1.3 Visits

Silke Horn, Aalto University, Finland, May 15–17, 2012

Hannes Meinlschmidt, Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS), Berlin, December 5–7, 2012

Andreas Paffenholz, Universität Bielefeld, December 5–6, 2011

Andreas Paffenholz, University of Sydney, Australia, November 9–18, 2012

Andreas Paffenholz, University of Queensland, Australia, November 18–25, 2012

Andreas Paffenholz, San Francisco State University, USA, June 13–16, 2011

Stefan Ulbrich, Rice University, Houston, USA, March 2011

Stefan Ulbrich, Rice University, Houston, USA, March 2012

6.2 Organization of Conferences and Workshops

Benjamin Assarf

- 3rd `polymake` Workshop, TU Darmstadt, March 22 and 23, 2012 (with Katrin Herr, Michael Joswig, Benjamin Lorenz, and Andreas Paffenholz)

Silke Horn

- 1st `polymake` Workshop, TU Darmstadt, March 31 and April 1, 2011 (with Katrin Herr, Sven Herrmann, Michael Joswig, Katja Kulas and Benjamin Lorenz, and Andreas Paffenholz)

Michael Joswig

- 1st `polymake` Workshop, TU Darmstadt, March 31 and April 1, 2011 (with Katrin Herr, Sven Herrmann, Silke Horn, Katja Kulas and Benjamin Lorenz, and Andreas Paffenholz)
- 2nd `polymake` Workshop, University of California, Berkeley, USA, September 13, 2011
- 3rd `polymake` Workshop, TU Darmstadt, March 22 and 23, 2012 (with Benjamin Assarf, Katrin Herr, Benjamin Lorenz, and Andreas Paffenholz)

Ulf Lorenz

- Minisymposium: Multistage Robustness at the 21st International Symposium on Mathematical Programming (ISMP), Berlin 19.08.12 - 24.08.12

Andreas Paffenholz

- 1st `polymake` Workshop, TU Darmstadt, March 31 and April 1, 2011 (with Katrin Herr, Sven Herrmann, Silke Horn, Michael Joswig, Katja Kulas and Benjamin Lorenz)
- 3rd `polymake` Workshop, TU Darmstadt, March 22 and 23, 2012 (with Benjamin Assarf, Katrin Herr, Michael Joswig, and Benjamin Lorenz)

Marc Pfetsch

- SCIP Workshop, October 2012, Darmstadt (with Sonja Mars)
- Workshop "Sparse Representation of Functions: Analytic and Computational Aspects", December 10–14, 2012, TU Berlin (with Gitta Kutyniok and Volker Mehrmann)

Sonja Mars

- SCIP Workshop, October 2012, Darmstadt (with Marc Pfetsch)

Stefan Ulbrich

- Local Organizer (Chair) and member of Organizing Committee SIAM Conference on Optimization 2011, May 16–19, 2011, Darmstadt
- Local Organizing Committee 83rd GAMM Annual Meeting, March 26–30, 2012, Darmstadt
- Local Organizing Committee Workshop on Modeling, optimization and simulation of complex fluid flow, June 20–22, 2012, Darmstadt
- Invited Minisymposium *Optimal Control of Hyperbolic Conservation Laws*, 25th IFIP TC 7 Conference, CSMO 2011, Berlin, September 12–16, 2011

Irwin Yousept

- Minisymposium: MS 358 Numerical PDE-constrained optimization (jointly with J.C. delos Reyes) at the 7th International Congress on Industrial and Applied Mathematics (ICIAM), Vancouver, Canada, July 18–22, 2011
- Matheon Workshop: Optimization with PDE constraints (application area C), Berlin, December 19, 2011

7 Workshops and Visitors at the Department

7.2 Seminar Talks

02/07/2011 Dr. Hassan Farshbaf-Shaker (Universität Regensburg), *A Relaxation approach to Allen-Cahn MPEC problems*

03/28/2011 Thomas Rehn (Universität Rostock),

03/29/2011 Brandon Dutra (University of California at Davis), *Software for Exact Integration of Polynomials Over Polyhedra*

04/11/2011 Prof. Dr. Martin Rumpf (Universität Bonn), *Multi-Scale Linear and Nonlinear Elastic Shape Optimization under Uncertainty*

05/24/2011 Prof. Juan Carlos De Los Reyes, Ph.D. (EPN Quito), *PDE-constrained optimization techniques for nonsmooth problems arising in fluid mechanics*

05/30/2011 Dr. Carsten Lange (Freie Universität Berlin), *Minkowski decompositions of associahedra*

06/06/2011 Dr. Xavier Allamigeon (École Polytechnique), *Algorithmics of tropical polyhedra, and application to software verification*

11/10/2011 Dr. Alexander Rahm (Weizmann Institute of Science), *Polyhedral models for arithmetic groups*

11/14/2011 Dr. Priska Jahnke (TU Darmstadt), *Fano-Varietäten*

12/07/2011 Pascal Benchimol (École Polytechnique), *Tropicalization of interior point methods in linear programming*

01/23/2012 Dr. Nicole Megow (TU Darmstadt/MPI Saarbrücken), *Scheduling unter Unsicherheit: Modelle, Algorithmen und Praxisanwendungen*

03/14/2012 Madhusudan Manjunath (MPI Saarbrücken), *Riemann-Roch theorems in discrete mathematics: an overview*

03/23/2012 Dr. Mathieu Dutour Sikirić (Rudjer Bosković Institute, Zagreb), *polyhedral: A GAP package for dual description and homology computations*

04/18/2012 Arnaud Padrol (Universitat Politècnica de Catalunya), *Many neighborly polytopes*

04/27/2012 Dr. Julian Pfeifle (Universitat Politècnica de Catalunya), *Removing symmetry from the Universal Polytope*

05/03/2012 Dr. Thomas Albrecht (Forschungszentrum Dresden Rossendorf), *Control of fluid flow using electromagnetic body forces*

05/07/2012 Dr. Benjamin Burton (University of Queensland, Brisbane), *Normal surface theory: Using the big machine*

05/07/2012 Prof. Stephan Tillmann (University of Sydney), *Cross ratios, representations and valuations*

06/13/2012 Dr. Nitin Ahuja (PTV AG), *Some Problems From The World Of Transport Logistics*

08/15/2012 Prof. Dr. Benjamin Nill (Case Western Reserve University, Cleveland), *Von Ehrhart-Theorie zu fast-nachbarschaftlichen Polytopen*

09/06/2012 Dr. Domenico Salvagnin (University of Padova), *Randomness and Tree Search/Approximating the first split closure*

09/10/2012 Prof. Dr. Sebastian Pokutta (Georgia Tech), *Linear Programming Formulierungen für das TSP Polytop*

12/06/2012 Prof. Dr. Dirk Pauly (Universität Duisburg-Essen), *Functional A Posteriori Error Estimates for Static Maxwell Type Problems*

12/10/2012 Prof. Francsico Santos (University of Santander), *Diameter of simplicial complexes and their combinatorial abstractions*

7.3 Visitors

Brandon Dutra (University of California, Davis), March 27–April 1, 2011.

Pascal Benchimol (École Polytechnique), November 2011.

Dr. Benjamin Burton (University of Queensland, Brisbane), May 7–11, 2012.

Dr. Jonathan Spreer (University of Queensland, Brisbane), May 7–11, 2012.

William Patterson (University of Queensland, Brisbane), May 7–11, 2012.

Prof. Dr. Stephan Tillmann (University of Sidney), May 7–11, 2012.

Prof. Dr. Benjamin Nill (Case Western Reserve University, Cleveland), August 13–16, 2012.

Prof. Dr. Christian Haase (Universität Frankfurt), December 10–14, 2012.

Prof. Francisco Santos (University of Santander), December 10–14, 2012.

Dr. Domenico Salvagnin (University of Padova), June 5–6, 2012.

Prof. Dr. Matthias Heinkenschloss (Rice University, Houston), June 2011, July 2012.

Prof. Dr. Bülent Karasözen (METU, Ankara), July 2011, July 2012.

Prof. Dr. Dirk Pauly (Universität Duisburg-Essen), December 3–9, 2012.

7.4 Workshops and Conferences

- 1st `polymake` Workshop, March 31 and April 1, 2011 (organized by Katrin Herr, Sven Herrmann, Silke Horn, Michael Joswig, Katja Kulas, Benjamin Lorenz, and Andreas Paffenholz)
- 3rd `polymake` Workshop, March 22 and 23, 2012 (organized by Benjamin Assarf, Katrin Herr, Michael Joswig, Benjamin Lorenz, and Andreas Paffenholz)
- SCIP Workshop 2012, October 8 to 10, 2012 (organized by Sonja Mars and Marc Pfetsch)
- SIAM Conference on Optimization 2011, May 16–19, 2011 (organized by Conference Co-Chairs: Michael Ferris, University of Wisconsin, USA, Stephen Vavasis, University of Waterloo, Canada; Local Chair: Stefan Ulbrich, TU Darmstadt)
- Workshop on Modeling, optimization and simulation of complex fluid flow, June 20–22, 2012 (organized by Dieter Bothe, Michael Schäfer, Stefan Ulbrich, TU Darmstadt and by Mária Lukáčová, Universität Mainz)

7.5 Scientific and Industrial Cooperations

Stefanie Bott

- Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Christian Brandenburg

- International Research Training Group (IGK 1529): "Mathematical Fluid Dynamics". Speaker Prof. Dr. Matthias Hieber (TU Darmstadt).

Carsten Schäfer

- LOEWE-Center AdRIA: Technological sector simulation tools.

Sarah Essert

- Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Jane Ghiglieri

- Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Tobias Fischer

- Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Thea Göllner

- Collaborative Research Centre (SFB) 666: "Integral sheet metal design with higher order bifurcations – development, production, evaluation". Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Kai Habermehl

- Collaborative Research Center (SFB) 805: “Control of Uncertainty of load carrying structures in mechanical engineering”. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering).

Imke Joormann

- Group of Dr. René Henrion, Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS), Berlin: Gas Transport Optimization.
- Group of Dr. Thorsten Koch (Zuse-Institut Berlin): Gas Transport Optimization.
- Group of Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Group of Prof. Dr. Werner Römisch (Humboldt-Universität Berlin): Gas Transport Optimization.
- Group of Prof. Dr. Rüdiger Schultz (Universität Duisburg-Essen): Gas Transport Optimization.
- Group of Prof. Dr. Marc Steinbach (Universität Hannover): Gas Transport Optimization.
- German Federal Network Agency (Bundesnetzagentur): Project “Technical Capacities of Gas Networks”.
- Open Grid Europe GmbH, formerly E.ON Gastransport GmbH: Project FORNE.

Michael Joswig

- Dr. Richard Bödi (ZHAW): Symmetric integer linear programs.
- Dr. Benjamin Burton (University of Queensland, Brisbane): “Algorithmic Methods in Combinatorial Topology”, Go8 Australia-Germany Joint Research Co-operation Scheme 2012/13 (German Academic Exchange Service).
- Prof. Dr. Wolfram Decker (TU Kaiserslautern): Mathematical software.
- Dr. Anton Dochtermann (Stanford University): Tropical convexity.
- Ewgenij Gawrilow (TomTom N.V.): Mathematical software.
- Prof. Dr. Stéphane Gaubert (École Polytechnique): Tropical convexity.
- Dr. Thilo Rörig (TU Berlin): Mathematical visualization.
- Prof. Dr. Raman Sanyal (FU Berlin): Tropical convexity.
- Prof. Dr. Bernd Sturmfels (Univerisity of California, Berkeley): Tropical geometry.
- Prof. Dr. Thorsten Theobald (Universität Frankfurt): Algorithmic geometry.
- Dr. Stephan Tillmann (University of Sydney): “Algorithmic Methods in Combinatorial Topology”, Go8 Australia-Germany Joint Research Co-operation Scheme 2012/13 (German Academic Exchange Service).
- Prof. Dr. Günter M. Ziegler (FU Berlin): Polytope theory.
- Priority Program 1489 (German Research Foundation): “Algorithmic and Experimental Methods in Geometry, Algebra, and Number Theory”, Speaker Prof. Dr. Wolfram Decker (TU Kaiserslautern).
- Graduate School GSC 233: “Computational Engineering”. German Excellence Initiative. Speaker: Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Daniela Koller

- Collaborative Research Centre (SFB) 666: “Integral sheet metal design with higher order bifurcations - development, production, evaluation”. Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Ulf Lorenz

- Prof. Dr.-Ing. Peter Pelz (TU Darmstadt): System optimization of the heating plant in the Darmstadtium.
- VDMA, KSB: System optimization of the heating plant in the Darmstadtium.
- Prof. Dr. Marco Platzner (Universität Paderborn): Computer Go.
- Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Quantified Linear Programs.
- Collaborative Research Center (SFB) 805: "Control of Uncertainty of load carrying structures in mechanical engineering". Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).
- German Research Foundation (DFG): Erweiterung mathematischer Optimierungsmethoden zur Lösung PSPACE-vollständiger Probleme mit Hilfe quantifizierter linearer Programme.
- Microsoft: PhD Sponsorship within the Micosoft Research PhD Scholarship program.

Hendrik Lüthen

- Collaborative Research Centre (SFB) 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation". Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Sonja Mars

- Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Solving mixed-integer semidefinite programs.
- Dr. Lars Schewe (Universität Erlangen-Nürnberg): Truss Topology Design and MISDPs.
- Collaborative Research Center (SFB) 805: "Control of Uncertainty of load carrying structures in mechanical engineering". Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Hannes Meinlschmidt

- Prof. Dr. Christian Meyer (TU Dortmund): Optimal control of the thermistor problem.
- Dr. Joachim Rehberg (WIAS Berlin): Optimal control of the thermistor problem.

Andreas Paffenholz

- PD Dr. Barbara Baumeister (Universität Bielefeld): Permutation Polytopes of Abelian Groups.
- Dr. Benjamin Burton (University of Queensland, Brisbane): "Algorithmic Methods in Combinatorial Topology", Go8 Australia-Germany Joint Research Co-operation Scheme 2012/13 (German Academic Exchange Service).
- Sandra Di Rocco (KTH Stockholm): Polyhedral Adjunction Theory.
- Prof. Dr. Christian Haase (Universität Frankfurt): Permutation, Cut, and Marginal Polytopes; Polyhedral Adjunction Theory; Unimodular Triangulations.
- PD Dr. Carsten Lange (Universite Pierre et Marie Curie (Paris VI)): Minkowski Decompositions of Generalized Permutahedra.
- Prof. Dr. Benjamin Nill (Case Western Reserve University, Cleveland): Permutation, Cut, and Marginal Polytopes; Polyhedral Adjunction Theory.
- Prof. Lindsay Piechnik (Duke University): Unimodular Triangulations.
- Prof. Francisco Santos (University of Santander): Unimodular Triangulations.

- Prof. Dr. Stephan Tillmann (University of Sydney): “Algorithmic Methods in Combinatorial Topology”, Go8 Australia-Germany Joint Research Co-operation Scheme 2012/13 (German Academic Exchange Service).
- Priority Program 1489 (German Research Foundation): “Algorithmic and Experimental Methods in Geometry, Algebra, and Number Theory”, Speaker: Wolfram Decker.

Anne Philipp

- LOEWE - Research Priority Program: “Cooperative Sensor Communication - Cocoon”. Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Abdelhak Zoubir (Department of Electrical Engineering, TU Darmstadt).

Sebastian Pfaff

- Priority Program (SPP) 1253: “Optimization with Partial Differential Equations”. Speaker Prof. Dr. Günter Leugering (Universität Erlangen-Nürnberg).

Marc Pfetsch

- Dr. Ralf Borndörfer (Zuse-Institut Berlin): Steiner Connectivity Problems.
- Group of Dr. René Henrion, Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS), Berlin: Gas Transport Optimization.
- Prof. Dr. Volker Kaibel (Universität Magdeburg): Symmetries in Integer Programming.
- Group of Dr. Thorsten Koch (Zuse-Institut Berlin): Gas Transport Optimization.
- Prof. Dr. Dirk Lorenz (TU Braunschweig): Compressed Sensing.
- Group of Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Group of Prof. Dr. Werner Römisch (Humboldt-Universität Berlin): Gas Transport Optimization.
- Group of Prof. Dr. Rüdiger Schultz (Universität Duisburg-Essen): Gas Transport Optimization.
- Group of Prof. Dr. Marc Steinbach (Universität Hannover): Gas Transport Optimization.
- Collaborative Research Center (SFB) 805: “Control of Uncertainty of load carrying structures in mechanical engineering”. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).
- Collaborative Research Centre (SFB) 666: “Integral sheet metal design with higher order bifurcations – development, production, evaluation”. Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).
- Graduate School GSC 233: “Computational Engineering”. German Excellence Initiative. Speaker: Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).
- German Federal Network Agency (Bundesnetzagentur): Project “Technical Capacities of Gas Networks”.
- Open Grid Europe (OGE): Project FORNE.

Rolf Roth

- Collaborative Research Centre (SFB) 568: “Flow and Combustion in Future Gas Turbine Combustion Chambers”. Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt).
- Dr. Sven Grundmann (TU Darmstadt): “Kernspintomographie zur Optimierung von Transportprozessen in technischen Apparaten”.

- Prof. Dr.-Ing. Cameron Tropea (TU Darmstadt): “Kernspintomographie zur Optimierung von Transportprozessen in technischen Apparaten”.

Adrian Sichau

- Collaborative Research Centre (SFB) 805: “Control of uncertainty of load carrying systems in mechanical engineering”. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Andreas M. Tillmann

- Marco Ament (Universität Stuttgart): Visualization of Astronomical Nebulae.
- Prof. Dr. Rémi Gribonval (INRIA Rennes - Bretagne Atlantique): Complexity of Cosparse Projection.
- Dr. Stefan Guthe (TU Braunschweig): Visualization of Astronomical Nebulae.
- Christian Kruschel (TU Braunschweig): SPEAR project.
- Prof. Dr. Dirk A. Lorenz (TU Braunschweig): SPEAR project, Visualization of Astronomical Nebulae, Compressed Sensing.
- Prof. Dr.-Ing. Marcus Magnor (TU Braunschweig): Visualization of Astronomical Nebulae.
- Prof. Dr. Marc E. Pfetsch (TU Darmstadt): SPEAR project, Compressed Sensing, Computational Complexity of Recovery Conditions.
- Prof. Dr. Daniel Weiskopf (Universität Stuttgart): Visualization of Astronomical Nebulae.
- Stephan Wenger (TU Braunschweig): Visualization of Astronomical Nebulae.

Stefan Ulbrich

- Graduate School GSC 233: “Computational Engineering”. German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).
- Graduate School GSC 1070: “Darmstadt Graduate School of Energy Science and Engineering”. German Excellence Initiative. Speakers Prof. Dr. Wolfram Jaegermann, Prof. Dr. Johannes Janicka (TU Darmstadt).
- Excellence Cluster EXC 259: “Center of Smart Interfaces: Understanding and Designing Fluid Boundaries (CSI)”. German Excellence Initiative. Speaker Prof. Dr.-Ing. Cam Tropea (Department of Mechanical Engineering, TU Darmstadt).
- Prof. Dr. Matthias Heinkenschloss (Rice University, Houston): PDE-Constrained Optimization, Model Reduction.
- Prof. Dr. Michael Herty (RWTH Aachen), Prof. Dr. Günter Leugering, Dr. Martin Gugat (Universität Erlangen-Nürnberg): Optimal control of switched networks for nonlinear hyperbolic conservation laws. Supported by DFG within SPP 1253.
- International Research Training Group IGK 1529: “Mathematical Fluid Mechanics” Speaker Prof. Dr. Matthias Hieber (Department of Mathematics, TU Darmstadt).
- Prof. Dr. Bülent Karasözen (METU, Ankara): DAAD Partnership Project “Optimization theory, methods and applications”.
- Prof. Dr. Jens Lang (TU Darmstadt): Adaptive multilevel SQP-methods for PDAE-constrained optimization with restrictions on control and state. Theory and Applications. Supported by DFG within SPP 1253.
- LOEWE-Center: “AdRIA: Adaptronik - Research, Innovation, Application”. Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

- LOEWE Research Priority Program: “Cooperative Sensor Communication – Cocoon”. Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Abdelhak Zoubir (Department of Electrical Engineering, TU Darmstadt).
- SFB 568: “Flow and combustion in future gas turbine combustion chambers”. Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt).
- SFB 666: “Integral sheet metal design with higher order bifurcations - development, production, evaluation”. Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).
- SFB 805: “Control of uncertainties in load carrying systems of mechanical engineering”. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).
- Dr. Anton Schiela (TU Berlin): Preconditioning Techniques for PDE-Constrained Optimization.
- Prof. Dr. Michael Ulbrich (TU München): Multilevel Methods for PDE-constrained Optimization.
- zeb/rolfes.schierenbeck.associates (Frankfurt): Mixed-Integer nonlinear optimization for credit portfolio optimization.

Irwin Yousept

- Prof. Dr. Fredi Tröltzsch (TU Berlin): PDE-constrained optimization in induction heating.
- Prof. Dr. Jürgen Sprekels (Humboldt-Universität Berlin, WIAS Berlin): Optimal control in crystal growth.
- Prof. Dr. Michael Hintermüller (Humboldt-Universität Berlin): Shape optimization techniques for magnetic induction tomography.
- Prof. Dr. Dirk Pauly (Universität Duisburg-Essen): A posteriori error analysis for Maxwell’s equations.
- Prof. Dr. Juan Carlos Delos Reyes (EPN, Quito): Optimal control of electrorheological fluids.
- Prof. Dr. Daniel Wachsmuth (Universität Würzburg): Hybrid Tikhonov and grad-div regularization.
- Prof. Dr. Christian Meyer (TU Dortmund): Elliptic optimal control problems with nonlocal radiation interface conditions.
- Dr. Sascha Schnepp (ETH Zürich): Discontinuous Galerkin for time optimal control problems of full first-order Maxwell’s equations.
- Dr. Antoine Laurain (TU Berlin): Shape optimization techniques for magnetic induction tomography.
- Dr. Pierre-Etienne Druet (WIAS Berlin): Optimal control in crystal growth.
- Dr. Olaf Klein (WIAS Berlin): Optimal control in crystal growth.