OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

MAGDEBURG LECTURES ON OPTIMIZATION AND CONTROL

Past Events

Katja Mombaur

Improving human-centered robots by model-based optimization

›Katja Mombaur (https://typo.iwr.uni-heidelberg.de/groups/orb/people/prof-katja-mombaur/)
Katja Mombaur is a full professor at the Institute of Computer Engineering of Heidelberg University and head of the Optimization, Robotics & Biomechanics Chair, as well as coordinator of the Heidelberg Center for Motion Research. She holds a diploma degree in Aerospace Engineering from the University of Stuttgart and a Ph.D. degree in Mathematics from Heidelberg University and has worked as a researcher at Seoul National University and in LAAS-CNRS in Toulouse. In 2020, she will join the University of Waterloo as Canada Excellence Chair for Human-Centered Robotics & Machine Intelligence. Her research focuses on understanding human movement by a combined approach of model-based optimization and experiments and using this knowledge to improve motions of humanoid robots and the interactions of humans with exoskeletons, prostheses and external physical devices.

Time & Place
The presentation on November 26, 2019 will be given in building 02, room 210 at the ›Otto-von-Guericke-University of Magdeburg (https://www.uni-magdeburg.de/) and starts at 5.00 p.m..

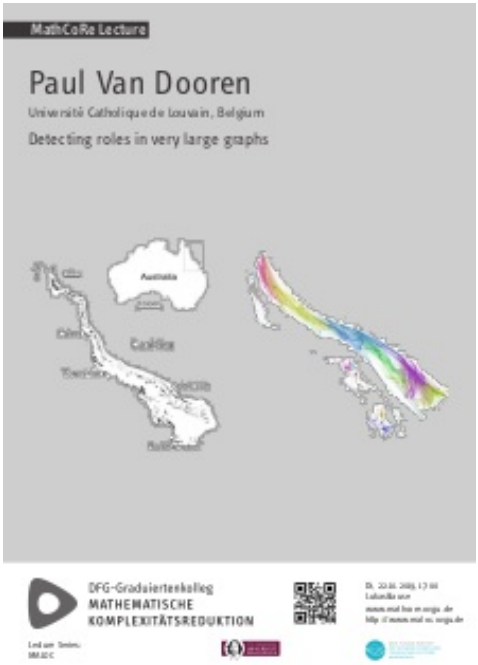
›more ... (https://www.maloc.ovgu.de/Past/Katja+Mombaur.html)

MathCoRe Lecture

Detecting roles in very large graphs

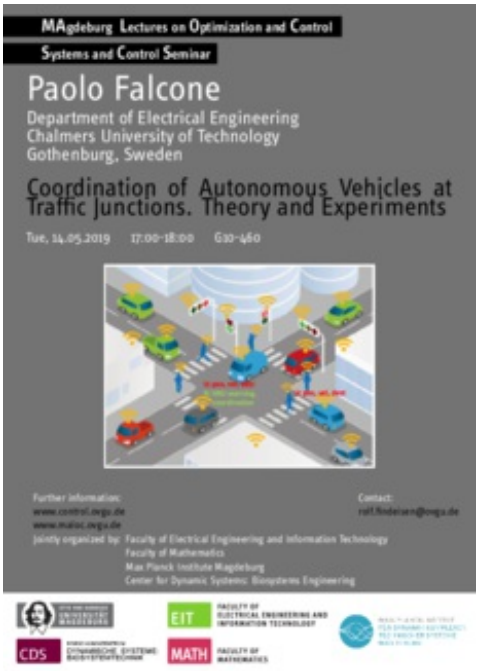
›Paul Van Dooren (https://perso.uclouvain.be/paul.vandooren/) Professor of Mathematical Engineering
Université Catholique de Louvain, Belgium

Time & Place
The presentation on October 22nd, 2019 will be given in the Lukasklause ›(Schleinufer 1, 39104 Magdeburg) (http://ifatwww.et.uni-magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klause.pdf) and starts at 5.00 p.m..



›more ... (https://www.maloc.ovgu.de/Past/Paul+Van+Dooren.html)

MathCoRe Lecture



Coordination of Autonomous Vehicles at Traffic Junctions.
Theory and Experiments

›Prof. Paolo Falcone (https://www.chalmers.se/en/Staff/Pages/paolo-falcone.aspx) Department of Electrical Engineering
Chalmers University of Technology
Gothenburg, Sweden

Time & Place

The presentation on May 14, 2019 will be given in building 10, room 460 at the ›Otto-von-Guericke-University of Magdeburg (https://www.uni-magdeburg.de/) and starts at 5.00 p.m..

Abstract

The next challenge, beyond high-level autonomous driving, is the coordination of autonomous vehicles, which is expected to fully enable the potential of autonomous driving technologies and heavily impact the society. Nevertheless, the safety and performance issues arising from the tight coupling between information losses and delays and the control system stability and performance must be accounted for at the design stage. Starting from a multi-vehicle coordination problem at traffic junctions, which has been experimentally demonstrated relying on both the IEEE 802.11p wireless standard and a 5G cellular network prototype, we will motivate a joint communication and control paradigm, where a central coordinator decides upon control inputs to a set of dynamical systems and their access to the communication channel. We will show a few results from numerical examples and new research directions.

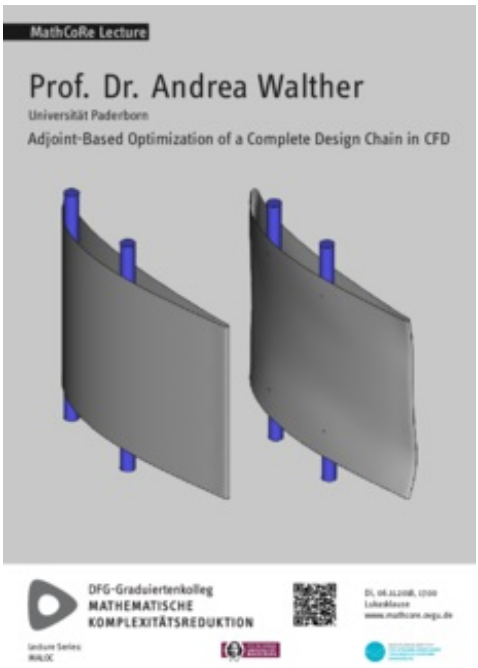
Short CV

Paolo Falcone is Associate Professor in the Mechatronics research group. His research focuses on constrained optimal control and verification methods, applied to autonomous and semi-autonomous mobile systems, cooperative driving and intelligent vehicles. He is involved in a range of projects, in cooperation with industry, focusing on autonomous driving, cooperative driving and vehicle dynamics

control. His teaching subjects include Model predictive control, Vehicle dynamics control and Modeling and simulation of dynamical systems.

›more ... (https://www.maloc.ovgu.de/Past/Paolo+Falcone.html)

MathCoRe Lecture



Adjoint-based optimization of a complete design chain in CFD

›Prof. Dr. Andrea Walther
(https://math.uni-paderborn.de/ag/mathematik-und-ihre-anwendungen/mitglieder-der-arbeitsgruppe/prof-dr-andrea-walther/) Institut für Mathematik
Universität Paderborn

Time & Place

The presentation on November 6, 2018 will be given in the Lukasklause ›(Schleinufer 1, 39104 Magdeburg) (http://ifatwww.et.uni-magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klause.pdf) and starts at 5.00 p.m..

Abstract

The complete design chain in Computational Fluid Dynamics (CFD) covers the parameterization of the object to be optimized like, e.g., an air foil, the usage of a Computer Aided Design (CAD) tool to actually construct the air foil and a flow solver to compute the flow around the air foil. The optimization of such a complete design chain that includes a CAD tool is still a severe challenge. In this talk we present the technique of algorithmic differentiation (AD) to compute exact derivative information for a given simulation code. We discuss how AD can be applied to the CAD kernel within OpenCASCADE Technology and a suitable flow solver taking also the complexity of the derivative information into account. We will see that a gradient-based optimization using adjoint information is the only tractable way. First numerical results for the optimization of a U-bend pipe used frequently as a cooling channel and of the TU Berlin stator as one example from turbo machinery are shown. This includes also a verification of the computed derivatives.

›more ... (https://www.maloc.ovgu.de/Past/Andrea+Walther.html)

MathCoRe Lecture

Global optimization of ODE constrained network problems on the example of gas transport

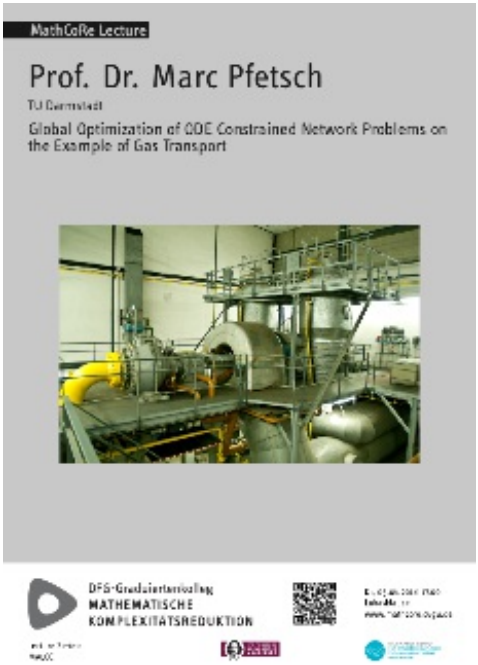
›Prof. Dr. Marc Pfetsch
(http://www.mathematik.tu-darmstadt.de/~pfetsch/) TU Darmstadt

Time & Place

The presentation on June, 5, 2018 will be given in the Lukasklause ›(Schleinufer 1, 39104 Magdeburg) (http://ifatwww.et.uni-magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klause.pdf) and starts at 5.00 p.m. (Historischer Raum).

Abstract

This talk considers a global optimization approach to solve mixed integer nonlinear optimization problems with ordinary differential equation constraints in network problems. We



combine techniques from mixed-integer nonlinear programming with an adaptive discretization of differential equations within a spatial branch-and-bound framework. We show that certain discretization schemes allow to construct lower and upper convex relaxations for the ODE constraints, which are then used to construct linear relaxations. This approach does not need to introduce additional variables for the different discretization nodes. We will illustrate our approach on the example of stationary gas transport and will present computational results.

›more ... (https://www.maloc.ovgu.de/Past/Marc+Pfetsch.html)

Neue Seite

Optimization based planning and feedback control: an on-going journey

›Gabriele Pannocchia
(http://www1.diccism.unipi.it/Pannocchia_Gabriele/Web/Welcome.html)
Associated Professor,
Department of Civil and Industrial Engineering,
University of Pisa

Time & Place
The presentation on March 19, 2018 will be given at the Otto-von-Guericke-University Magdeburg, Universitätsplatz 2, building 7 - room 208 and starts at 5 p.m..

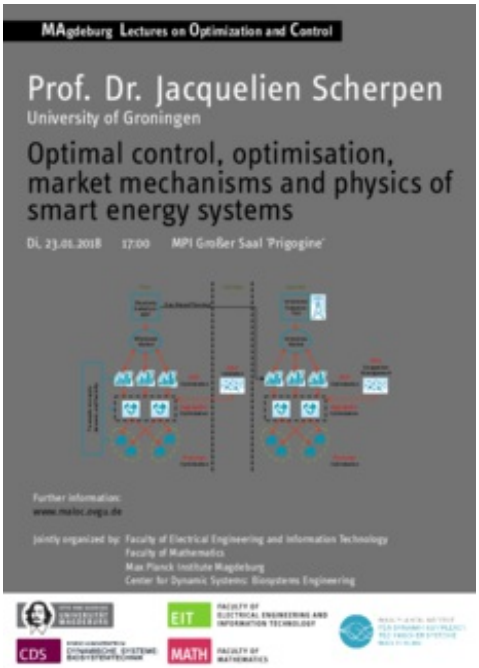
Abstract
Optimization based strategies for planning and feedback control represent a general framework of numerical methods in which a (often deterministic) model of the system under consideration and its environment are exploited to achieve high-level goals (e.g., minimization of energy consumption, emission of pollutants, maximization of throughput, etc.) as well as more specific tasks (e.g. product quality control, robotic manipulation), while respecting a number of constraints arising from physical, safety or performance limits.

In this seminar, I review and analyze the main concepts, successes and ongoing challenges of optimization based methods, with a particular emphasis on how uncertainties can be dealt with effectively and efficiently using disturbance estimation techniques. During the seminar, I present several examples ranging from reaction processes to robotic systems.

›more ... (https://www.maloc.ovgu.de/Past/Gabriele+Pannocchia.html)

Optimal control, optimisation, market mechanisms and physics of smart energy systems

›Prof. dr. ir. Jacquelien M.A. Scherpen
(https://www.rug.nl/staff/j.m.a.scherpen/cv?lang=en)



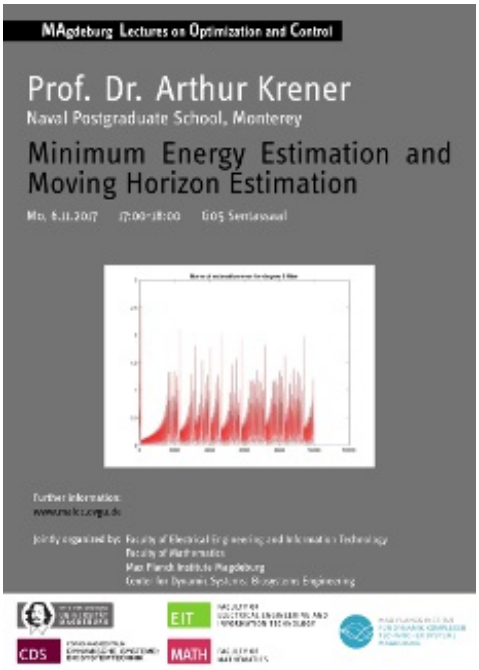
University of Groningen

Time & Place
The presentation on January 23, 2018 will be given in the ›Max Planck Institute Magdeburg (http://www.mpi-magdeburg.mpg.de/), Großer Seminarraum 'Prigogine' and starts at 5.00 p.m..

Abstract
In this talk I will first give a combined distributed, hierarchical optimal control perspective using dual decomposition and pricing mechanisms for smart energy systems, and in particular for household prosumers (consumers and producers). In this setup a possible future (EU) market structure is taken into account. Furthermore, I will take a second perspective from the physics, where stabilisation is important, and optimisation is done on the welfare function. Some questions about the coupling of these two perspectives are raised.

›more ... (https://www.maloc.ovgu.de/Past/Jacquelien+Scherpen.html)

Arthur Krener



Minimum Energy Estimation and Moving Horizon Estimation

›Prof. Dr. Arthur Krener
(https://www.math.ucdavis.edu/research/profiles/?fac_id=krener)
Naval Postgraduate School, Monterey

Time & Place
The presentation on November 6, 2017 will be given in the Senatssaal (G05) and starts at 5.00 p.m..

Abstract
Minimum Energy Estimation is a way of filtering the state of a nonlinear system from partial and inexact measurements. It is a generalization of Gauss' method of least squares. Its application to filtering of control systems goes back at least to Mortenson who called it Maximum Likelyhood Estimation \cite{Mo68}. For linear, Gaussian systems it reduces to maximum likelihood estimation (akaKalman Filtering) but this is not true for nonlinear systems. We prefer the name Minimum Energy Estimation (MEE) that was introduced by Hijab \cite{Hi80}. Both Mortenson and Hijab dealt with systems in continuous time, we extend their methods to discrete time systems and show how power series techniques can lessen the computational burden.

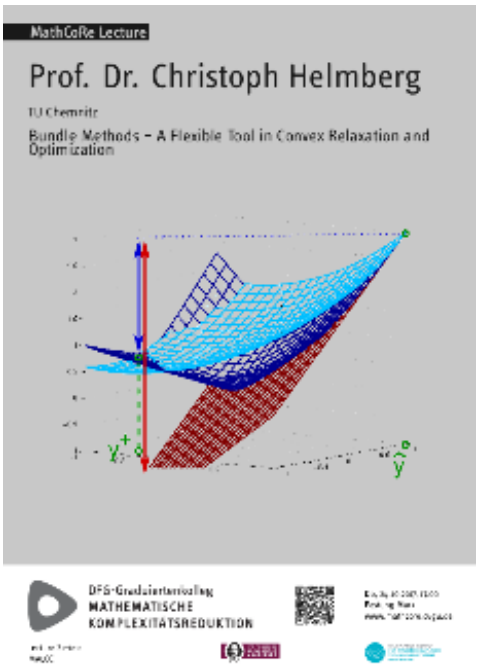
Moving Horizon Estimation (MHE) is a moving window version of MEE. It computes the solution to an optimal control problem over a past moving window that is constrained by the actual observations on the window. The optimal state trajectory at the end of the window is the MEE estimate at this time. The cost in the optimal control problem is usually taken to be an L2 norm of the three slack variables; the initial condion noise, the driving noise and the measurement noise. MHE requires the buffering of

the measurements over the past window. The optimal control problem is solved in real time by a nonlinear program solver but it becomes more difficult as the length of the window is increased.

The power series approach to MME can be applied to MHE and this permits the choice of a very short past window consisting of one time step. This speeds up MHE and allows its real time implementaion on faster processes. We demonstrate its effective on the chaotic Lorenz attractor.

›more ... (https://www.maloc.ovgu.de/Past/Arthur+Krener.html)

Christoph Helmberg



Bundle Methods -- A Flexible Tool in Convex Relaxation and Optimization

›Prof. Dr. Christoph Helmberg (https://www-user.tu-chemnitz.de/~helmberg/)
TU Chemnitz

Time & Place
The presentation on October 24, 2017 will be given in the Festung Mark (oberes Gewölbe) and starts at 5.00 p.m..

Abstract
Solution approaches for large scale integer or stochastic optimization problems frequently employ Lagrangian relaxation or decomposition in order to break the problem into manageable pieces. Suitable multipliers are then determined by nonsmooth convex minimization algorithms. In this, subgradient algorithms are frequently employed because they are easy to implement and they have optimal convergence properties for first order oracles. Bundle methods try to make better use of the same information by collecting it over time. While their convergence properties are hard to pin down, the choice of the cutting model and proximal term offers a lot of flexibility to adapt the method to ones needs. The choice of the proximal term allows to introduce scaling information. When dealing with sums of convex functions bundle methods open new possibilities for asynchronous parallel optimization approaches. In semidefinite optimization a specialized cutting and scaling model allows to move from first order towards second order behavior. In Lagrangian relaxation the generation of approximate primal solutions admits primal cutting plane approaches. Based on examples from scheduling, train timetabling and graph partitioning we illustrate a selection of these aspects, highlight some of the theory involved and discuss a few implementational issues arising in the callable library ConicBundle.

›more ... (https://www.maloc.ovgu.de/Past/Christoph+Helmberg.html)

A data-driven modeling framework for dynamical systems

›Prof. Dr. Serkan Gugercin (http://www.math.vt.edu/people/gugercin/)
Virginia Tech

Time & Place
The presentation on July 18, 2017 will be given in the Lukasklause ›(Schleinufer 1, 39104 Magdeburg) (http://ifatwww.et.uni-magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klause.pdf) and starts at 5.00 p.m. (Großer Saal).

Abstract: We present a data-driven non-intrusive modeling approach for large-scale dynamical systems with linear state dependence. Traditionally, reduced models are constructed in an intrusive projection-based framework, where the operators of the full model are required either explicitly in an assembled form or implicitly through a routine that returns the action of the operators on a vector. Our non-intrusive approach constructs reduced models directly from trajectories of the inputs and outputs of the full model, without requiring the full-model operators. These trajectories are generated by running a simulation of the full model; the method then infers frequency-response data from these simulated time-domain trajectories and uses the data-driven Loewner and Vector Fitting frameworks to derive a reduced model. Only a single time-domain simulation is required to derive a reduced model with the new data-driven non-intrusive approach. We demonstrate the proposed methodology on various benchmark examples and test its robustness in the case of noisy measurements.
›more ... (https://www.maloc.ovgu.de/Past/Serkan+Gugercin.html)

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