Universität Konstanz

Fachbereich Mathematik und Statistik

Prof. Dr. S. Volkwein und JunProf. Dr. G. Ciaramella

Wir laden recht herzlich zu einem Vortrag im Rahmen des

Oberseminars Numerische Optimierung

ein:

Prof. Dr. Martin Schmidt

(Universität Trier)

Mixed-Integer Nonlinear Optimization for District Heating Networks

Dienstag, 15. Dezember 2020

Beginn: **16:00 Uhr**
Raum: **BigBlueButton Room: https://bbb.uni-konstanz.de/b/gab-nez-v4u**
Interessenten sind herzlich willkommen!

S. Volkwein

Abstract:

In this talk we consider the optimal control and the optimal expansion of district heating networks.

First, we discuss a complementarity-constrained nonlinear optimization model for the time-dependent control of district heating networks. The main physical aspects of water and heat flow in these networks are governed by nonlinear and hyperbolic 1d partial differential equations. In addition, a pooling-type mixing model is required at the nodes of the network to treat the mixing of different water temperatures. This mixing model can be recast using suitable complementarity constraints. The resulting problem is a mathematical program with complementarity constraints subject to nonlinear partial differential equations describing the physics. In order to obtain a tractable problem, we apply suitable discretizations in space and time, resulting in a finite-dimensional optimization problem with complementarity constraints for which we develop a suitable reformulation with improved constraint regularity. Moreover, we propose an instantaneous control approach for the discretized problem, discuss practically relevant penalty formulations, and present preprocessing techniques that are used to simplify the mixing model at the nodes of the network. Finally, we use all these techniques to solve realistic instances. The numerical results show the applicability of our techniques in practice.

In the second part of the talk, we present a mixed-integer nonlinear optimization model for computing the optimal expansion of an existing tree-shaped district heating network given a number of potential new consumers. To this end, we state a stationary variant of the model discussed in the first part of the talk. The expansion decisions are modeled by binary variables for which we derive additional valid inequalities that greatly help to solve the highly challenging problem. Finally, we present a case study in which we identify three major aspects that strongly influence investment decisions: the estimated average power demand of potentially new consumers, the distance between the existing network and the new consumers, and thermal losses in the network.

(eingeladen von Prof. Dr. Stefan Volkwein)