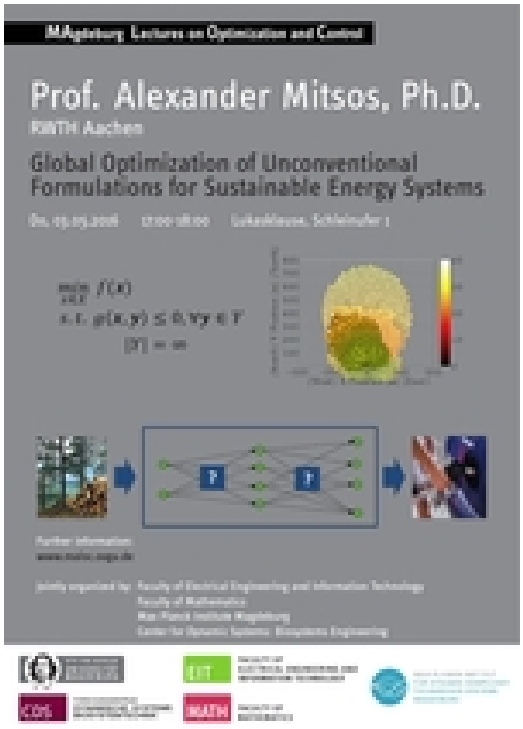
OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

MAGDEBURG LECTURES ON OPTIMIZATION AND CONTROL

Alexander Mitsos



Global Optimization of Unconventional Formulations for Sustainable Energy Systems

Prof. Dr. Alexander Mitsos

RWTH Aachen University

Time & Place

The presentation on May 3, 2016 will be given at the Lukasklause, Schleinufer 1, Magdeburg and starts at 5.00 p.m.

Abstract

The presentation gives an overview of the group's recent and current work on energy systems and describes some highlights in more detail. The focus is on the optimal design of renewable energy systems, in particular concentrated solar thermal, geothermal and biomass conversion. We discuss optimal layout, optimal design and optimal operation over time scales (hourly, daily, seasonal). We also discuss hybrid systems consisting of more than one energy source with the goal of synergetically combining sources with different characteristics. These systems have characteristics that are different from conventional energy systems, namely the combination of turbomachinery and chemical processes, pronounced uncertainty and time-variability. As a result, these systems need to be addressed using systematic methods from process systems engineering and at the same time can be utilized to identify and overcome limits in these methodologies. In the last decade, algorithms for deterministic global optimization of mixed-integer nonlinear programs (MINLP) have undergone major changes rendering the solution of challenging optimization problems possible. We utilize these advantages to optimize several renewable energy systems using state-of-the-art codes. However, we also demonstrate that the optimization of several systems is not possible using these codes due to mainly two reasons, namely scaling of computational complexity with size of problems and the fact that natural formulations for many problems do not follow the traditional MINLP. To address these problems we develop theory for the scaling of algorithms and algorithms for unconventional formulations and utilize them for energy systems. In particular we discuss embedded/hierarchical programs (bilevel, semi-infinite, differential-algebraic systems with optimization embedded) and how these problems can be solved. We finally briefly discuss open challenges in optimization theory and algorithms and in energy systems.

Short CV

Alexander Mitsos is a Full Professor (W3) in RWTH Aachen University, and the Director of the Laboratory for Process Systems Engineering (AVT.SVT), comprising 40 research and administrative staff. Mitsos received his Dipl-Ing from University of Karlsruhe in 1999 and his Ph.D. from MIT in 2006, both in Chemical Engineering. Prior appointments include military service, free-lance engineering, involvement in a start-up company, a junior research group leader position in the Aachen Institute of Computational Engineering Science and the Rockwell International Assistant Professorship at MIT. Mitsos has over 80 peer-reviewed publications and has received a number of awards. His research focuses on optimization of energy and chemical systems and development of enabling numerical algorithms.