



Lothar-Collatz-Kolloquium für Angewandte Mathematik

Donnerstag, den 04. Juli 2024, um 17:15 Uhr, im Hörsaal 5

Prof. Dr. Stefan Ulbrich*

(Technische Universität Darmstadt, FB Mathematik)

"Robust optimization techniques for PDE-constrained optimization under uncertainty"

Zusammenfassung/Abstract:

The consideration of uncertainty in optimization problems is an important aspect in many practical applications. In this talk we consider optimization problems with partial differential equation (PDE) constraints, where uncertainty occurs in parameters (for example material parameters, usage scenarios) as well as in the optimization variables (e.g. manufacturing tolerances). There exist several approaches to handle uncertainty in optimization, in particular stochastic optimization, probabilistic constraints and (distributionally) robust optimization.

In this talk we will focus on robust and distributionally robust optimization approaches for problems with expensive PDE-constraints. In robust optimization, relevant realizations of the uncertain variables are described by an uncertainty set and it is required that the optimization variables satisfy critical constraints for all realizations of the uncertain variables in the uncertainty set. In distributionally robust optimization one considers an ambiguity set of relevant distributions for uncertain parameters and requires that the constraints are satisfied in expectation for all distributions in the ambiguity set.

The resulting robust formulation is a semi-infinite optimization problem and can be written in a min-max form. We present various techniques how to approximate and reformulate the robust problem by using optimality conditions and duality theory in order to obtain a tractable problem. Depending on the approach, the reformulation contains conic constraints, complementarity conditions and conjugate functions.

Moreover, we will illustrate, how adjoint techniques as well as model order reduction and error estimation can be used to solve these problems efficiently in the PDE constraint case.

We present several application examples, in particular the design optimization of electric machines under uncertainty.

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