Multiobjective Optimization of PDEs using Reduced-Order Modelling

Dr Stefan Banholzer

University of Konstanz

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Abstract:

Many optimization problems in applications can be formulated using several objective functions which are conflicting with each other. This leads to the notion of multiobjective optimization problems for which the goal is to compute the set of optimal compromises (the Pareto set) between the conflicting objectives. In this talk we present two approaches for solving multiobjective optimization problems governed by partial differential equations (PDEs). First we introduce a continuation method, which computes the Pareto set by using a predictor-corrector type algorithm. The second approach is given by reference point methods, which belong to the class of scalarization methods. For both approaches we show analytically that the Pareto set can be computed and illustrate these results with some numerical examples. However, while solving the multiobjective optimization problem numerically, the PDE has to be solved numerous times. Thus, reduced-order models for the PDE are used to decrease the numerical effort. One key issue is to guarantee that the solutions to the reduced-order model are close to the truth solutions throughout the optimization routine. Here we discuss two ways of tackling this problem: On the one hand computing the reduced-order model prior to the start of the optimization routine, and on the other hand adapting the reduced-order model during the optimization when necessary. For both approaches we present both analytical and numerical results, which show that it is possible to gain a significant reduction in computing time while maintaining a desired level of accuracy.

This is joint work with M. Dellnitz, B. Gebken, S. Peitz (all Paderborn University) and S. Volkwein (University of Konstanz).