

PDE-Constrained Optimization under Uncertainties

Seminar, Project or Thesis

Project description

In most applications, one does not only ask for a simulation, but for some kind of decision or design based on a simulation, e.g. optimal shapes of airplane wings or the temperature control of a melting process. This can be mathematically formulated as a constrained optimization problem. Such constrained optimization problems (especially if the model is described by a partial differential equation) are a subject of current research. Many times, however, some parameters or input data of the model are not exactly known (e.g. uncertain flow profile or uncertain heat conductivity). It is therefore of interest to study the influence of these uncertain parameters on the optimization. The toolset to study the propagation of uncertainties through models is provided by the field of Uncertainty Quantification. The uncertain parameters are viewed as random variables, and are parametrized. The parametrized system is solved with methods that are similar to PDE numerics (stochastic Galerkin, stochastic collocation). Combining these techniques provides a way to answer the question as to how sensitive the optimization is to uncertainties, by constraining the optimization functional by a stochastic Galerkin or collocation system. This approach has been followed by Tiesler et al.

Possible tasks

- Study the literature on UQ and PDE-constrained optimization
- Confirm the results from the paper by Tiesler et al.
- Extend the paper by applying the techniques to other sets of equations

Literature

- H. Tiesler, R. M. Kirby, D. Xiu, T. Preusser, *Stochastic collocation for optimal control problems with stochastic PDE constraints*, SIAM J. Optim. 50 (2012) 2659-2682.

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