InAD - Institut für Akustik und Dynamik

Technische Universität Braunschweig

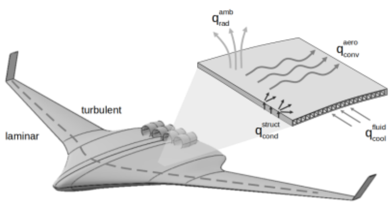
Uncertainty Quantification for Multiphysics Systems

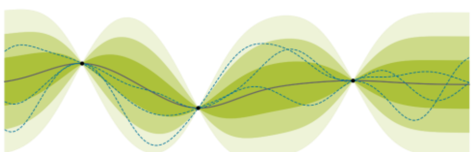
Bachelor Thesis | Student Research Project | Master Thesis

Numerous modern engineering challenges involve different physical disciplines. In a joint project with other research institutions, we are numerically investigating how heat from fuel cells in future electrically powered aircraft can be dissipated via the aerodynamic surfaces. This "skin heat exchanger" requires interrelated consideration of three fields: The cooling-channel fluid, the structure and the external aerodynamics. We use the Finite Element Method (FEM) and the Finite Volume Method (FVM) for this purpose.
To accomplish this task, we often have to simulate multiple variations of the same multiphysics system. In addition to optimization, uncertainty quantification is an important multi-query application. This is particularly relevant for modeling new technologies, which are subject to various uncertainties while valid predictions must nevertheless be ensured. However, the long runtime of multiphysics simulations is a major obstacle.
Machine learning techniques, such as Gaussian processes, are used to generate surrogates that can be quickly evaluated. We explore innovative methodological approaches, starting with simple benchmarks, and further develop these methods while ensuring their practical applicability to the project's objectives.

Prerequisites:
- Interest in challenging numerical problems
- Programming experience in Python (beneficial)

What to expect:
- Multiphysics simulation (FEM/ FVM)
- Machine learning (e.g., Gaussian processes)





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