Multifidelity Uncertainty Quantification for Compressor Blading Design

Project Description

The need for a sustainable and environmentally friendly aviation presents new challenges for engine design. Since todays aircraft and engines are designed by following a single design point development process, one way to improve efficiency is to aim for a high performance during all or most flight phases. For this, it is necessary to proceed towards a development process that can adapt to different flying conditions and requirements and that can also cover multidisciplinary aspects. Since the compressor performance is crucial for an engine's overall efficiency, it is possible to increase performance by designing compressor blades capable of adapting themselves to different flying conditions, such as cruise and take-off or climbing. The SE^{2}A C3.1 project aims to design shape-variable compressor blading, capable of morphing for improving efficiency under different aerodynamic conditions by using structurally integrated actuators.

Uncertainties can play an important role in compressor blading design, and their quantification is crucial to reliably access the benefits of shape adaptive approaches. However, uncertainty quantification can be computationally very challenging. Indeed, propagating uncertainties in material or geometry parameters through the structural model may easily require thousands of finite element simulations, which is unfeasible. In this project the aim is to analyze uncertainties in the blade tip and camber displacement due to variability in structural parameters. To make the uncertainty quantification task tractable, a multifidelity approach will be used, which fuses data from simulation sources of different fidelity. The starting point will be the multilevel Monte Carlo method, where different resolutions of the finite element mesh are used to reduce the variance of standard Monte Carlo samplers. Depending on the progress, the approach will be generalized to more heterogeneous model families of different fidelity.

Requirements

Prospective candidates should have a master degree in computational science and engineering, mechanical engineering or a related field. A deeper knowledge in either structural computational mechanics or uncertainty quantification is appreciated. Very good skills in English and programming are required.

The project will be jointly supervised by Zhuzhell Montano Rejas (DLR) and Ulrich Römer (TU Braunschweig)

Contact information

Applications should be sent by e-mail to Jun.-Prof. Dr.-Ing. Ulrich Römer: u.roemer@tu-braunschweig.de

The entry date is as soon as possible, and the duration of employment is limited to 6 months. The position is part-time with 50% of the regular weekly working time (currently 19,9h). Ongoing applications are possible until all positions are filled. The payment is made according to task assignment and fulfillment of personal requirements to salary group EG 13 TV-L. International applicants may have to successfully complete a visa process before hiring can take place. Candidates with handicaps will be preferred if equally qualified. Please enclose a proof. The position is part of the SE²A International Female Programme, so only applications by female graduates of non-German universities are possible. All documents should be in PDF format, preferably in a single file. Personal data and documents relating to the application process will be stored electronically. Please note that application costs cannot be refunded.