Two PhD-Researcher Positions within the SE²A Research Cluster on

Flow Physics of Load Reduction

Technische Universität Braunschweig, Germany

Background: The Cluster of Excellence *SE²A – Sustainable and Energy Efficient Aviation* (www.tu-braunschweig.de/se2a) is a DFG-funded interdisciplinary research center investigating technologies for a sustainable and eco-friendly air transport system. Scientists from engineering, economics, chemistry, and biology are working on the reduction of drag, emissions, and noise, life-cycle concepts for airframes, improvements in air traffic management, and new technologies for energy storage and conversion. Technische Universität (TU) Braunschweig, the German Aerospace Center (DLR), Leibniz University Hannover (LUH), Braunschweig University of Art (HBK), and National Metrology Institute of Germany (PTB) have joined forces in this extraordinary scientific undertaking. The overall project is structured into the three core research areas "Assessment of the Air Transport System", "Flight Physics and Vehicle Systems", and "Energy Storage & Conversion".

As part of the Cluster of Excellence, a Junior Research Group (JRG) has been established with a focus on *"Flow Physics of Load Reduction"*. Aircraft wings are subject to dynamic loads caused by unsteady gusts and flight maneuvers, which reduce passenger comfort and induce structural wing deformations that are typically countered by sturdier and, consequently, heavier wing designs. Based on conceptual design studies, drastic reductions of maneuver and gust loads offer large gains on the overall aircraft level. Leveraging these gains for future aircraft calls for new knowledge on aerodynamic means to re-distribute or suppress aerodynamic loads on the wing. The objective of this JRG is to substantiate feasibility of efficient and rapid means of load redistributions, aiming for load envelopes corresponding to less than 1.5g loads for maneuvers and gust encounters.

Approach: *How can lift forces be locally generated or suppressed with the required magnitude and in the required timeframe?* Drastic redistribution of lift forces must be implemented over the whole flight regime from subsonic to transonic flow conditions. Conventional control surfaces and spoilers may be too slow and require too much system power. Therefore, pneumatic actuation concepts for manipulating the Kutta condition as well as attaining actuation by viscous mechanisms of separation suppression or provocation to provide the necessary reaction speeds at moderate actuation power may be appropriate. The approach is to conduct unsteady flow simulations of flow control on 2D wing segments and 3D wings of finite span for a range of actuation and geometric parameters. Subsonic and transonic flow conditions will be studied separately due to the different flow mechanics. The simulation results will be validated by wind tunnel experiments on representative 2D and 3D wing models in wind tunnels of DLR and TU Braunschweig. A detailed description of the project, preliminary work plan, and JRG is available here:
https://www.tu-braunschweig.de/ism/se2a

Employment: We are looking for two outstanding, enthusiastic, and self-motivated candidates to join our research team in one of the following two PhD-Researcher positions (for detailed information, please refer to the linked position descriptions):

1) B2.A – Numerical Investigation of Active Load Reduction on Sub- and Transonic Wings
2) B2.B – Experimental and Numerical Investigation of Active Load Reduction on Subsonic Wings

The two PhD-Researcher positions are located at the *Institute of Fluid Mechanics* at *TU Braunschweig, Germany*. The desired start date is June 1st 2019 and the duration is initially limited to four years. The positions are part-time suitable, but should be occupied 100%. The payment is made according to task assignment and fulfillment of personal requirements to salary group TV-L E13. International applicants may have to successfully complete a visa process before hiring can take place. Applications from international scientists are welcome. TU Braunschweig aims to increase the share of women in academic positions. Applications from female candidates are explicitly encouraged. Where candidates have equal qualifications, preference will be given to female applicants. Candidates with disabilities will be preferred if equally qualified. Please enclose a proof. TU Braunschweig offers programs that support young female scientists and international researchers. The university has been certified since 2007 as a "Family-Friendly University" and the Family Office supports employees and students in balancing family and employment responsibilities.

Application Process: The desired start date for the two positions is June 1, 2019. All applications received before April 26, 2019 will be given full consideration, but the positions are open until filled. Applications should be sent by e-mail to se2a@tu-braunschweig.de and must contain the following documents:

- Letter of Motivation
- Curriculum Vitae including complete address, phone number, email address, educational background, language skills, and work experience
- Copies of Bachelor and Master certificates and transcript of grades in original language and in English or German translation
- Scientific writing sample authored by the candidate (e.g. Master thesis, conference paper)
- Names of 1-3 potential referees

All documents should be in PDF format, preferably in a single file (except for the scientific writing sample). Please specify in your application which of the two positions you are applying for. Personal data and documents relating to the application process will be stored electronically. Please note that application costs cannot be refunded.

PhD-Researcher Position B2.B within the SE²A Research Cluster

Experimental and Numerical Investigation of Active Load Reduction on Subsonic Wings

Temporary Position (4 years), Salary Level TV-L E13, 100%

Background: Aircraft wings are subject to dynamic loads caused by unsteady gusts and flight maneuvers, which reduce passenger comfort and induce structural wing deformations that are typically countered by sturdier and, consequently, heavier wing designs. To reduce the wing weight, gust and maneuver load alleviation systems are already in use in today's aircraft, where they dynamically actuate existing control surfaces like ailerons or elevators to alter the wing lift distribution during an unsteady load encounter. These systems, however, suffer from the relatively slow response of conventional control surfaces and therefore cannot exploit the full potential of gust and maneuver load alleviation. The Junior Research Group (JRG) on *"Flow Physics of Load Reduction"* within the SE²A (*Sustainable and Energy Efficient Aviation*) Research Cluster will contribute to the development of a new generation of Active Load Reduction systems by investigating the flow physics and control authority of dedicated flow actuators that have the potential to provide fast, efficient, and load-dependent lift redistribution over the entire wingspan.

The PhD-Researcher Position B2.B focuses on wind tunnel tests and unsteady flow simulations of 2D airfoils and 3D wings with dedicated flow field actuators for subsonic flow conditions. The position will closely collaborate with a second PhD-Researcher within the JRG and other groups of the SE²A Cluster.

Specific Tasks for Position B2.B:

- Survey and preliminary investigation of potential actuator concepts
- Numerical analysis of selected actuator concepts on 2D wing sections and fully-3D wings
- Design, manufacturing, and testing of 2D and 3D wind tunnel models for validation experiments
- Development, optimization, and validation of Reduced Order Models based on numerical and experimental data
- PhD degree can be acquired

Who we are looking for:

- Outstanding candidates who have completed or are in the process of completing a Master Degree in Aerospace Engineering, Mechanical Engineering, or a comparable field
- Team-oriented, reliable, and self-motivated work attitude
- Solid knowledge of fluid mechanics, ideally flow control, experimental methods, and CFD
- Experience with one or more of the following techniques: force balances, surface pressure measurements, Particle Image Velocimetry, wind tunnel testing
- Excellent oral and writing skills in English
- Good programming skills (e.g. C, C++, Fortran, Python), Linux
- Experience with Matlab, CAD software, FE analysis, and reduced order models is an advantage

Application instructions: https://www.tu-braunschweig.de/Medien-DB/se2a/PhD_JRG_B2.pdf