Professorship for Experimental Fluid Dynamics
TUM School of Engineering and Design
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Reynolds number effects on the performance of a model wind turbine in a pressurized wind tunnel

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Wind turbine performance depends critically on the Reynolds number, $Re_D = \rho U D/\mu$, which governs the aerodynamic regime experienced by the rotor blades. Recent field studies have shown that true Reynolds-number independence is not achieved until $Re_D \sim 10^7$, far beyond what conventional wind tunnels can reproduce at matched tip-speed ratios (TSR). To achieve higher Reynolds numbers, our group uses the Variable Density Turbulence Tunnel (VDTT) located at the Max Planck Institute for Dynamics and Self-Organization in Göttingen. This pressurised wind tunnel uses SF_6 up to 15 bar as the working fluid to span $1 \times 10^4 \leq Re_D \leq 2 \times 10^7$ on a model wind turbine — a range that bridges laboratory and field-scale conditions in a controlled environment.

Our current campaign uses the MoWiTO 0.6, a model wind turbine developed at the University of Oldenburg, to study the effects of Reynolds number and pitch angle of the blade on the performance of the wind turbine. We are looking for a motivated master's student to lead the experimental campaign: designing new blades, characterising the drivetrain's internal losses, and running a new measurement campaign in the VDTT.

Project description:

- Adapt the IEA 15 MW rotor for the model wind turbine and perform OpenFAST simulations to compare it to the previous rotor design. OpenFAST is a widely used wind turbine modelling software developed by the National Renewable Energy Laboratory (NREL) in Colorado, USA.
- Design and construct a test stand to characterise the internal losses of the drivetrain and calibrate the strain gauges used to measure the thrust on the rotor.
- Conduct a measurement campaign in the VDTT in Göttingen to measure the performance of the wind turbine with the new rotor design.
- Use the data to find insights into the effects of Reynolds number and optimal pitch angle on the performance of a wind turbine.
- Possibility to contribute to a journal paper to publish the findings.

Model wind turbine (MoWiTO 0.6).

Wind tunnel (VDTT) in Göttingen.

Candidate profile:

- Enrolled in a master's programme in mechanical engineering, aerospace engineering, or a closely related field.
- Solid foundation in fluid mechanics and aerodynamics.
- Hands-on laboratory experience and comfort working with mechanical and electrical systems.
- Proficiency in at least one scientific programming environment (MATLAB, Python, or equivalent).
- Willingness to spend some time at the Max Planck Institute for Dynamics and Self-Organization in Göttingen to conduct the experiments (accommodation will be provided).
- Ability and desire to work in a diverse and international team.
- Good command of English. German language skills are not required.

How to apply:

Please send a single PDF to akhil.borra@tum.de with the subject line *"MSc Application — MoWiTO"* containing the following:

- A brief cover letter (max. 1 page) describing your motivation and relevant experience.
- Your current CV.
- Transcripts of your BSc and any completed MSc coursework.

Please also include your desired start date in the email.