

## Bachelor/Master Thesis

### Stiffness Distribution and Composite Layup Design of a Scaled-Down Rotor Blade for Wind Tunnel Testing

#### Description

Currently, premature fatigue damage in bonded joints, sandwich panels and laminates of rotor blade structures is a common phenomenon, and this damage can manifest itself within 10% of the total blade life. In recent years, some progress has been made in ISD in understanding, modeling and predicting the fatigue of polymers in adhesives and fiber-reinforced composites. For validation of these models under fatigue loading induced by aerodynamic excitation, wind tunnel testing is essential. But one of the challenges is the limited availability of space within the wind tunnel which does not allow the testing of full-scale rotor blade. This necessitates the development of a scaled down model which is best possible representation of the full-scale blade. Therefore, the central research question concerns determining the stiffness distribution along the blade span to ensure appropriate dynamic response under aerodynamic excitation. To this end, simplified finite element (FE) beam models can be utilized to determine the required stiffness distribution. The composite layup has to be subsequently designed to achieve this target stiffness profile. This work provides an excellent opportunity to gain hands-on experience with numerical and optimization tools, while contributing to ongoing research efforts supporting the clean energy transition. In addition, the candidate will benefit from close supervision and dedicated support during the course of the thesis.

#### Task/Work Programme

- Research on full scale blades in literature to get deflection profile.
- Development of a suitable method for downscaling of blade.
- Implementation and testing
- Persuasive presentations and documentation

#### Your Profile

- Student of Civil Engineering (ideally with focus on Wind Energy), Mechanical Engineering or Computational Engineering
- Analytical thinking and organised style of working
- Team player
- Working language: English or German

#### Supervisor:

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