Semester / Master Thesis

Institute of Rotorcraft and Vertical Flight

Fatigue Analysis of Rotor and Propeller Blades

Keywords: Fatigue, Rotor Blade, Propeller Blade, FEM, Structural Mechanics, Lifetime Analysis, Test Rig, Helicopters, VTOL

Background: Rotor and propeller blades are subjected to complex cyclic loads during operation, which significantly influence their structural integrity and lifetime. Reliable fatigue assessment therefore requires both numerical simulation methods and experimental validation approaches.
This student research project addresses fatigue investigations of rotor and propeller blades and can be conducted in **one of two alternative topics**, depending on the student's interests.

Topic A: Fatigue Simulation of Rotor and Propeller Blades

The focus of this topic is the numerical fatigue analysis of rotor and propeller blades. A basic finite element model of the blade is already available and will be extended for fatigue investigations.

Scope of work:

- Literature research on suitable **materials and fatigue models**
- Investigation of classical fatigue assessment methods
- Implementation of fatigue models into an existing simulation framework
- Lifetime estimation under representative load cases
- Comparison of different modelling approaches
- Investigation of potential **structural optimizations** to improve fatigue life

Topic B: Conceptual Design of a Fatigue Test Rig for Rotor and Propeller Blades

This topic focuses on the experimental side of fatigue investigations. The objective is the conceptual design of a test rig suitable for fatigue testing of rotor or propeller blades.

Scope of work:

- Review of existing fatigue test rigs and testing concepts
- Definition of requirements for rotor/propeller blade fatigue testing
- Development of a **test rig concept**
- Evaluation of different loading and excitation concepts
- Assessment of feasibility and applicability of the proposed solutions

About us: We are looking for an independent and highly motivated Master's students who wants to develop their knowledge in the areas of propeller and rotorblade structures & dynamics, FEM simulation, structural dynamics. These theses offer an excellent opportunity to participate in applied and industry-related research. If you are interested, please contact us personally. We will be happy to discuss all possibilities!

Abilities: High motivation and the ability to familiarize yourself independently with new topics. Experience with structural dynamics is beneficial, but not necessary.

Language: German or English

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