Determining Sources of Pitch Control Inaccuracies in Whirl Tower using Optical Methods

Project Outline

The MERIT test rig is a whirl tower featuring an 85kW motor and constant-rpm control, capable of monitoring rotor blade behaviour in a variety of extreme flight conditions, most notably deep dynamic stall in a two-blade configuration. Currently the blade pitch can be varied by shifting the position and angle of the swashplate, however, the pitch of the two blades is never quite the same – there is often an offset between the two blades. There are a few different sources where this inaccuracy may come from: the leeway in the blade holder connections; the flexibility in the tension-torsion straps that counteract the centrifugal force; the deformation of the pitch links due to centrifugal force; just to name a few examples. We have a few different methods we could employ to investigate this – for example optical methods have been used to determine the blade deformation, and have begun to be implemented measuring blade holder deformation as well. We also have access to high-speed cameras that could be used to film the rotor head or blades during operation, giving a more detailed insight.

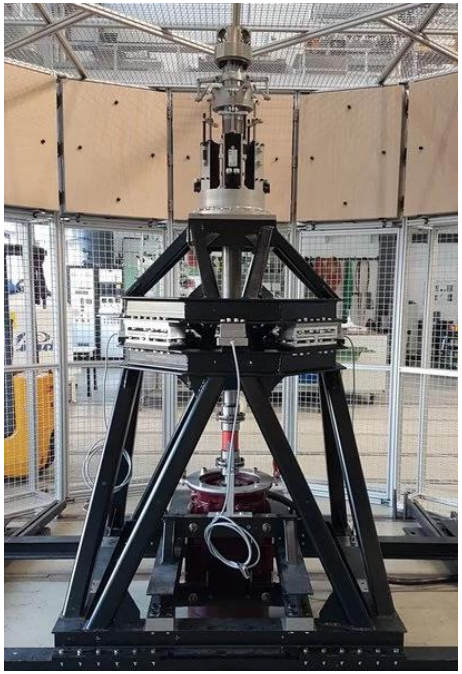

Fig 1: The MERIT Test rig, without blades attached

Project Plan and Milestones

- Familiarisation with the Test Rig hardware, and literature review on other Test Rigs, focusing on the problems they faced during development.
    - **MS1: Exposé outlining which factors are to be investigated, and how**
- Put these investigations into practice, e.g. through optical methods
    - **MS2: Defining which components need modifications to improve pitch accuracy**
- If time permits: develop concepts to improve pitch accuracy
    - **MS3: Engineering Drawings of newly designed parts**

Prerequisites:

Basic understanding of rotor dynamics
German language beneficial but not required

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