

Visualising Blade Aerodynamics in a Rotating System on the MERIT Whirl Tower

Background:

The MERIT Test Rig (pictured) is a Whirl Tower designed specifically for dynamic stall (unsteady flow separation) investigations in a rotating system. Much of the instrumentation up until this point has been focussed on the structural responses to dynamic stall, however I want to push this more into aerodynamic measurement. A cheap and relatively easily implemented way to visualise flow is by attaching strings to the blade, and filming how the strings respond to stimuli using high speed cameras. Implementing this in Wind Tunnels is frequently done, however having the strings in a rotating system is rare. Some challenges that may need to be overcome are: the effect of centrifugal force on the strings; the response time of the strings compared to the vortex phenomenon being measured; the measurement accuracy of the system in place, etc. The aim of the task would be to extract a complete data set from which the effect of individual parameters on the aerodynamics can be empirically drawn.

Contact:

Matti Mitropoulos
matti.mitropoulos@tum.de
089 289 16370
Office: MW2701

Project Outline and Milestones:

- Literature Review on previous examples of string visualisation in flow fields
 - MS1: Expose outlining project
- Initial Testing to establish feasibility of strings on blades, and developing DAQ chain
 - MS2: Obtain first flow field measurements, either 2D or ideally 3D
- Parameter Sweep through established inputs (rpm, collective pitch, cyclic pitch)
 - MS3: Complete data set for those parameters
- Derive empirical conclusions from data set available
 - MS4: Final report

Prerequisites:

- Experience with experimental DAQ systems
- High level understanding of rotating systems / unsteady aerodynamics
- Problem solving skills and organised work ethic

