

# PROPOSAL MASTER THESIS

Siemens Digital Industries Software  
Simulation3D RTD

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## **OBJECTIVE:**

### **Downscaling pitch bearing test-benches for wind turbine applications via Smart Virtual Sensing**

In order to test new pitch bearing designs for use in wind turbine blade/hub connections, large scale test-benches are typically used. Here, a hub/bearing/blade setup is considered where representative loads are applied to the blade in order to measure and retrieve Key Performance Indicators (KPIs) of interest, e.g. peak stresses and strains as experienced by the pitch bearing. To simplify this testing and validation procedure, small-scale test-benches could be used if these test-benches could replicate the Key Performance Indicators (KPIs) of interest. A potential approach could be to use Smart Virtual Sensing techniques to estimate the required (unknown) loads that would have to be applied to the small-scale test benches to replicate the KPIs of interest as measured on large scale test-benches.

Optimal Sensor Placement (OSP) strategies can significantly reduce the number of sensors required for the Smart Virtual Sensing approach. Within the context described above, novel OSP strategies to distributed load and material parameter estimation of wind turbine blades are of interest as well to further optimize the down-scaled test-bench approach.

Therefore, the goals of the internship are as follows:

- To investigate how Smart Virtual Sensing techniques can be used to replicate large scale test bench KPIs on small scale test benches
- To investigate how an optimal set of sensors can be used for distributed load and material parameter Smart Virtual Sensing applications

Within this internship, the following tasks are foreseen:

- Finite Element and Flexible Multibody modeling of pitch bearing test rigs using Siemens Simcenter 3D software
- Using and extending prototype Matlab and Python Smart Virtual Sensing frameworks
- Extending Optimal Sensor Placement algorithms for distributed load and parameter Smart Virtual Sensing applications