Proposal 2015-2016

Topic #3 - Development of an experimental platform dedicated to wind turbine default detection

Contacts

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Context

Wind turbines are large and flexible structures experiencing different types of excitations. The sources of excitation can be classified in two classes: dynamic and aerodynamic. The former is the well-known unbalanced rotor, generating periodic loads on the shaft and the mast. On the other side, different types of aerodynamic phenomena can take place: flow separation (stall flutter), misalignment of the flow with the rotor or turbulent content of the incoming wind. In this case the vibrations will mainly take place on the blades of the rotor. In both situations, the resulting vibrations will impact the integrity and the power output of the wind turbine.

In the scope of this project, the Wind Tunnel Laboratory (ULg), Microsys (ULg) and the company V2i plan to develop an experimental platform dedicated to test a small scale Horizontal Axis Wind Turbine (HAWT). For that purpose, wireless sensors, measuring 3 axis accelerations will be used to monitor the vibration behaviour of the three blades and the hub of the turbine.

Wireless sensor at the tip of the blade

Objectives

The objective of this final year project is to develop an integrated methodology to investigate the effect of dynamic and aerodynamic excitations on a HAWT: from its instrumentation (vibration and power output), up to the development of detection tools.

It will be coupled with a long internship (min 80 days). The bulk of the work will be carried out at the company site and at the wind tunnel laboratory of University of Liège.

The internship includes the following tasks:

- Design of an acquisition system of the time signal acquired by the wireless sensors. Labview is preferred.
- Study of the potential of auto-powering feature of the wireless sensor.
- Design and fabrication of modified blades to enhance the vibration of the HAWT.
- Design of the support for the HAWT capable to activate the different sources of excitation.
- Instrumentation of the HAWT.

The TFE will consist in:

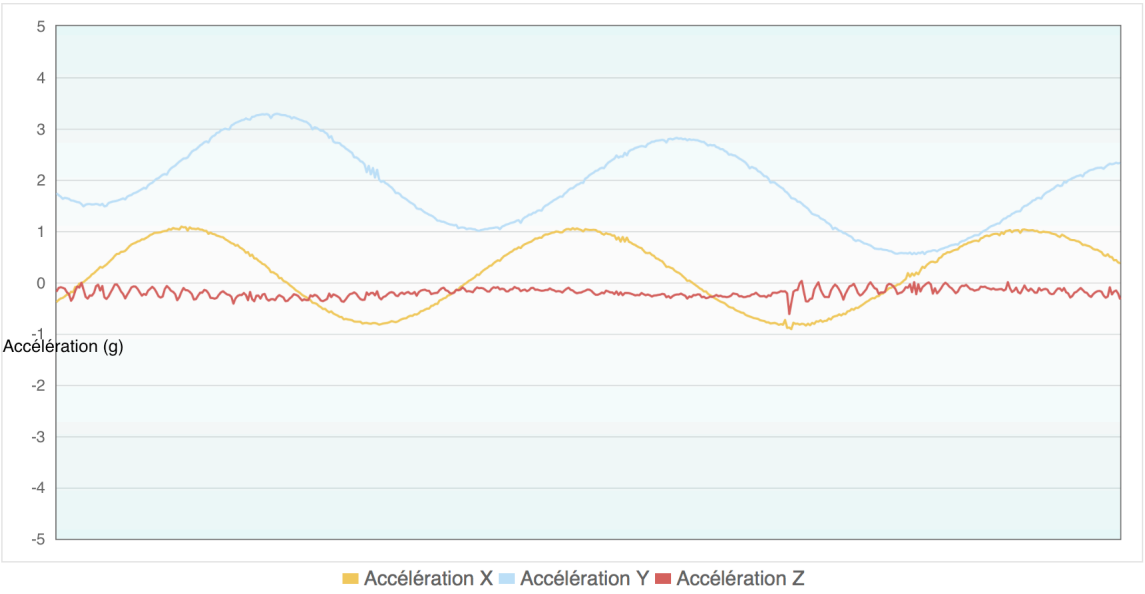
- Literature research about HAWT monitoring.
- Development of detection algorithms
- Carrying out wind-tunnel test campaigns.
- Demonstrating the applicability and the robustness of the system.
- Up-scaling and transposing the implemented system to VAWT and large scales HAWT.

Profile

The student must have some familiarity with structural dynamics, fluid mechanics and be highly motivated. Following courses are recommended:

- MECA0029-1 - Theory of vibration
- MECA0062-1 - Vibration testing and experimental modal analysis
- AERO0032 - Aeroelasticity and Experimental Aerodynamics (fall semester)

In addition, the student must be acquainted with Matlab and Labview environments.



Example of 3-axis acceleration measured at the tip of the blade