Monitoring of Rotating Machines in evolving and unstable environnement : Application to wind turbines.

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Research background

The efficiency of a wind farm has to rely on a highly specialized monitoring strategy, predicitve enough to ensure an optimal running time of its machines. Today, windfarm operator are using already tested and validated conditional monitoring devices coming from other energy production fields. Concerning rotating machines monitoring, traditional techniques mainly consider vibration signals. Thus, most of regular systems gets the accelerometric signal through a constant time sampling. Consequently, speed fluctuations are not permitted when using it and adapting such systems to the erratic load of a wind turbine is inappropriate. An original angular observation method freeing from this drawback will simultaneously be developed, experimented and optimized over conventional accelerometric and over instantaneous angular speed signals in a Maia Eolis wind turbine.

As a part of the smart machine project, this work uses the original angular measurement progress and enlightens the foremost simulation and identification skills developed in the laboratory.

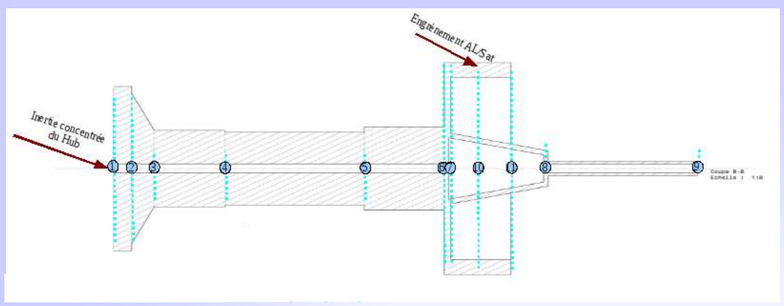
Milestones

- Conceive a global and original angular measuring system dedicated to the wind turbine
- Develop processing tools adapted to each faults that threatens rotating elements of the turbine line shafting.
- Define an automated monitoring strategy on one machine with the foremost progresses.

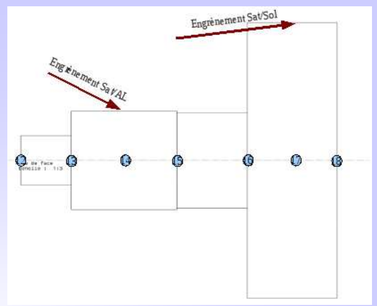
Methods

- Develop and use a test rig to adapt and test processing tools for angular monitoring.
- Simulate the line shaft to identify the sensor location and to yield relevant diagnostics.

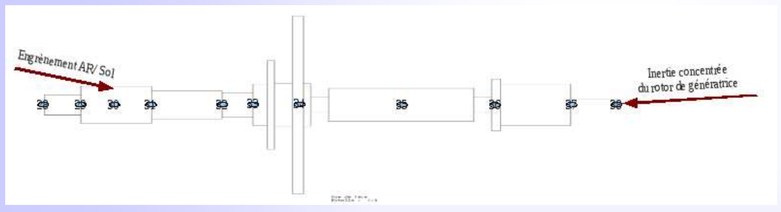
First model of the line shafting



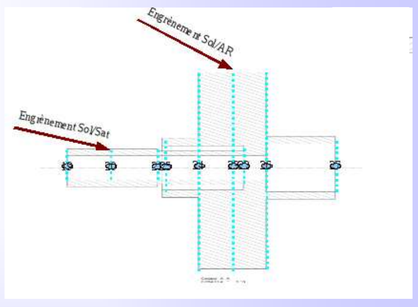
Low speed shaft (ring gear)



Planet



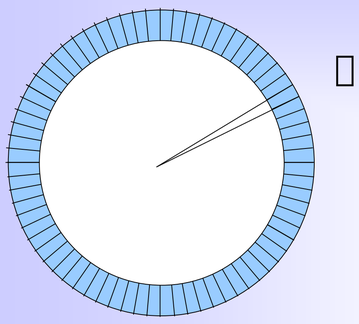
High speed shaft



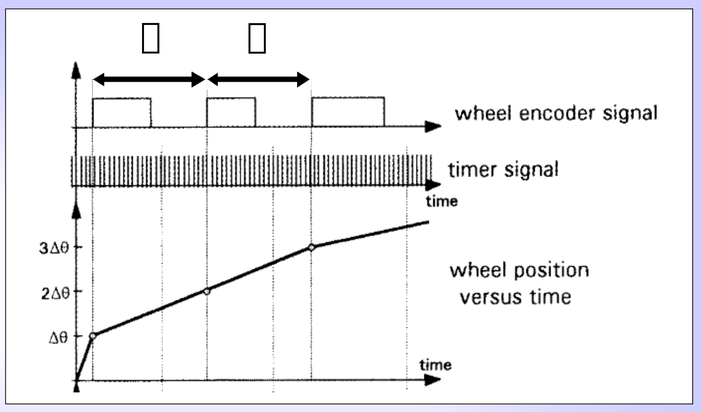
Sun

This first torsional model of the line shafting will first be empirically validated and eventually upgraded with coupling nodes (Torsion-Bending).

Instantaneous angular speed

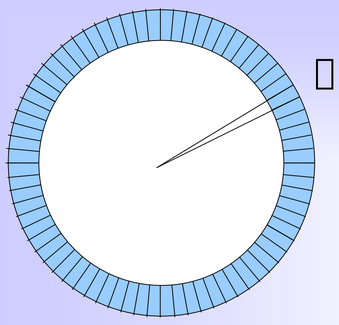


Angular encoder

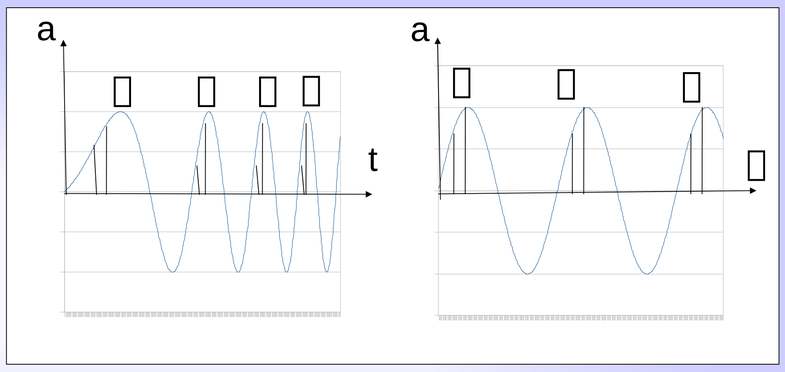


Principle: time measure between two consecutive impulses from the rotating sensor.

Angular Accelerometric sampling

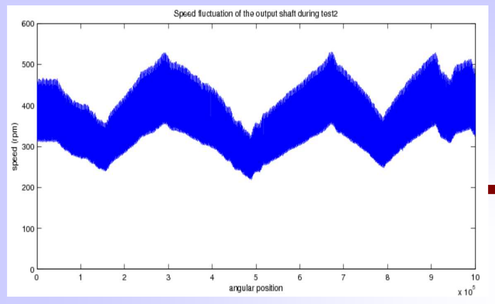


Angular encoder



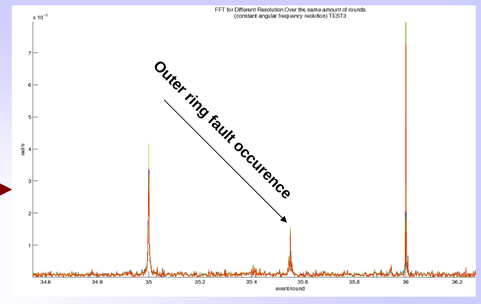
Principle: Accelerometer sampling rythmically assessed by the rotating sensor impulses.

First results from the test rig



Instantaneous Angular Speed

Discret Fourrier Transform



Order spectrum of the IAS

Through real angular sampling, a simple DFT makes the fault clearly visible even on this very non stationnary measure.

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