

Condition Monitoring of a Wind Turbine with an IMU on the Main Shaft

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ABSTRACT

Acceleration sensors for Condition Monitoring (CM) in Wind Turbines (WT) are usually placed on non-rotating elements such as the nacelle or the tower. Sensorizing blades, though desirable, is much less frequent since it poses serious practical limitations in terms of powering, communication, installation and maintenance.

As an alternative to circumvent such limitations we propose the use of an Inertial Movement Unit (IMU) placed on the rotor main shaft. On the one side, this location is not only much more sensitive to rotor and blade dynamics but also captures that of the tower. On the other, the influence of harmonics associated to the rotation (1P, 3P) can be minimised. Moreover, if the precise rotor position (azimuth) is known, failures or events associated to a given position can be more easily identified, and through a change of spatial reference system to a fixed framework, accelerations of the tower can be extracted as if they were obtained from a sensor in the nacelle or the tower.

In this paper we will show examples of the information that, through signal processing techniques, can be obtained from the proposed sensor. We also propose a method that, from the tachometer-less estimation of the azimuth from the IMU signals (3 axis accelerations and angular velocities), allows generating three axial tower accelerations referenced to the ground. The rotating sensor proposed can thus work as either a stand-alone device, or to be combined with the information provided by other sensors. Our methods are validated with both synthetic and measured signals.