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”DATA2#2 - Wind turbine gearbox condition monitoring through a multi-scale data-driven approach”

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Since wind is expected to play a crucial role on the worldwide electricity production scenario, the reliability of the turbines is attracting attention from industry as well from the scientific community. New techniques for efficient condition monitoring of the key components can be fundamental in order to optimize the performance and the maintenance of a large fleet of turbines. The gearbox represents the most critical component, as it is responsible for a large part of the wind turbine downtime during its overall life. Anyway, monitoring for wind turbine gears is challenging due to the non-stationarity of the operation and the lack of noise-free vibration measurements. In the present work, a new approach for long to medium term efficient monitoring of wind turbine drivetrains has been developed basing on real-world data. An incipient fault on the drivetrain of a turbine has been used as a test case for developing a new approach based on the use of multi-scale data sources. On one side SCADA (Supervisory Control And Data Acquisition) data have been used for a general monitoring of the state of the machine’s component while, on the other hand, high multi-resolution data from triggered events collected by a CMS (Condition Monitoring System) were used to refine the diagnosis and prognosis of the fault. Even if triggered events are difficult to be used when classifying a target machine with a healthy reference, the results demonstrate that the use of CMS multi-scale high resolution data can be much more effective in the fault diagnosis. In the present work, the one class-SVM (Support Vector Method) was used for novelty detection. Its effectiveness in unveiling the faulty machines is observed to be strongly boosted by the application of the dimensionality reduction through the PCA (Principal Component Analysis). The approach, when using all the available time scales, is able to detect the incoming fault also several years in advance and can therefore be proposed as a more robust approach with respect to the classical data-driven regression normal behaviour model developed with continuously available SCADA data.

Presenter(s) : CASTELLANI FRANCESCO

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