S3 Meeting April 2022

9H30-9H45
CT S3 news

9h45-10H15

Degradation of a wind-turbine drive-train under turbulent conditions: effect of the control law

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Abstract:

Comparation of the simulated degradation produced at the drive-train of a given wind turbine when it is functioning at optimal and sub-optimal operating points. The simulation considers different classes of wind conditions and supposes the use of the same Maximum Power Point Tracking (MPPT) algorithm but calibrated with different feedback gains. The dissipation at the drive-train is modeled using contact mechanics principles, and it is intended for modeling the mechanical fatigue due to changes in wind speed and turbulence. The work presents the proposed model for the drive-train degradation and the obtained power curves for a simulated variable-speed 2MW (100m rotor diameter) wind turbine, with fixed gear box and horizontal-axis.

10H15-10H45

Local Mahalanobis Distance Envelope Using A Robust Healthy Domain Approximation For Incipient Fault Diagnosis

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Abstract:

Incipient fault diagnosis is an important and challenging issue in academic and industrial communities but got insufficient attention. The subtle and slowly increasing deviations of key system parameters raise the security risk and should be detected in their early stage. However, the tiny changes of the observed signals are usually blurred with noise, resulting in the unsatisfying performance of most existing fault diagnosis approaches. As one of the data-driven approaches, one-class classification methods are well suitable to solve the fault detection problem for their powerful feature representation ability and unsupervised characteristic, while the specific improvement for incipient faults is still required. In early works, the local Mahalanobis distance, which is effective to non-linear data and sensitive to incipient faults, was proposed and shown its outstanding performance compared to typical multivariate statistic methods. Nevertheless, this method's performance degenerates when training samples contain outliers. To cope with this issue, we propose a robust healthy domain approximation based on a specific anchors-generating algorithm to improve the local Mahalanobis distance calculation. Simulation results show that the new proposed anchors-generating algorithm can significantly avoid the interference caused by outliers and then develop a performed healthy domain approximation for a more accurate fault detection procedure. The comparison result between our proposal and other one-class classification methods highlights the efficiency of the proposed solution for incipient fault detection.

Keywords:
Healthy domain approximation; One class classification; Local Mahalanobis Distance; Fault detection; Incipient fault

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10H45-11h15

Sensor Fault diagnosis using parity space approach. Application on a photovoltaic generator

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Abstract

The performance of photovoltaic generators (GPV) is intrinsically linked to the operating, manufacturing or environmental conditions and which in most cases results in faults.
This article deals with the issues related to the isolation and identification of faults in a complex industrial process in application to a non-linear system represented by its mathematical and electrical model. An application has been proposed on a nonlinear model, due to the atypical behavior of the semiconductors used in the panels.
We propose an original method of detection, isolation and identification of faults, based on the method of parity space, with a view to its application to the diagnosis of fault sensor. The idea is based on the generation of residuals, the detection by the dynamic cumulative sum and the isolation of faults. The proposed diagnostic method, combined with mastery in modeling the PV generator, enabled us to characterize the impact and influence of sensor faults using two simulations using Simulink and Matlab. The simulation results presented here highlight the isolation of sensor faults, which signify the sensitivity of the diagnostic method applied to the system studied.

11h15-11H45

A new scheme for fault detection based on Optimal Upper Bounded Interval Kalman Filter

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Abstract

(OUBIKF) and an adaptive degree of freedom Chi-squared statistics method. It is devoted to discrete time linear models subjected to mixed uncertainties in terms of observations and noises. Mixed uncertainties mean both bounded and stochastic uncertainties. The degrees of freedom of this Chi-squared hypothesis test method are adaptively chosen thanks to amplifier coefficients improving the detection of the sensor faults. The proposed approach is an extension of a result developed in Lu et al. (2019). Application on a vehicle bicycle model highlights the efficiency of the proposed approach. Comparisons with other efficient estimation and fault detection strategies are provided to discuss the accuracy of the obtained results.

11h45-12H15

Predictive maintenance policy for geographically dispersed systems under limited resources

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Abstract:

In the context of industry 4.0, digital technologies lead production systems to reach a new level of efficiencies and responsiveness to customers. To adapt to geographical dispersion of customers, a new model of production system, named geographically dispersed production system (GDPS), has emerged. GDPS are characterized by a high level of complexity and the requirements for availability of these systems are very high. Predictive maintenance can be relevant to fulfill these requirements but the problem of availability of sufficient resources, such as specific devices, technicians and spare parts can have a strong impact.

Limited resources problem represents a big challenge for maintenance, however, it has not been investigated widely in the literature. The objective of our work is to present and discuss a predictive maintenance policy, considering limited resources of maintenance for a GDPS, to minimize the total maintenance cost rate. To illustrate our policy, we consider an offshore wind turbines field, following a k-out-of-n reliability structure. The wind turbines are considered as gradually deteriorating devices and located far apart from each other. Maintenance is carried out in the context of maintenance rounds which require specialized equipment available for a limited maximum period. Hence, maintenance resources are considered limited. The main challenge of our work is to respect the available resources of maintenance while considering jointly the degradation level and the time to move between units. The performances of the proposed predictive maintenance policy are illustrated by various numerical examples.