Deep learning for automated drivetrain fault detection

A novel data-driven deep-learning system for large-scale wind turbine drivetrain monitoring applications is presented. It uses convolutional neural network processing on complex vibration signal inputs. The system is demonstrated to learn successfully from the actions of human diagnostic experts and provide early and robust fault detection on both rotor bearing, planetary and helical stage gear box bearings from analysis of multisensor vibration patterns using only a high-level feature selection. On the basis of data from 251 actual wind turbine bearing failures, we are able to accurately quantify the fleet-wide diagnostic model performance. The analysis also explores the time dependence of the diagnostic performance, providing a detailed view of the timeliness and accuracy of the diagnostic outputs across the different architectures. Deep architectures are shown to outperform the human analyst as well as shallow-learning architectures, and the results demonstrate that when applied in a large-scale monitoring system, machine intelligence is now able to handle some of the most challenging diagnostic tasks related to wind turbines.