

# Deep Detection: An Unsupervised Representation to Detect Anomalies in Raw Condition Monitoring Signals

Falling costs and increased reliability of sensing devices and data transmission have allowed condition monitoring to become near ubiquitous for many complex engineered systems. The data collected is usually high-dimensional and in high frequency sampling. Therefore, it is difficult or resource demanding to handle the raw condition monitoring data with traditional model- and knowledge-based approaches.

Due to the availability of massive amounts of data, new approaches that are able to extract the relevant features from raw data are required, for the purpose of detecting the fault onset and subsequently extract the health indicators to determine the remaining useful life.

In this talk, we will present an approach for automatically learning the relevant features and detecting faults without reliance on expert knowledge. This objective is achieved by stacked autoencoder based on extreme learning machines. The approach is applied to two different systems: 1) bearings under accelerated degradation tests and 2) generator in combined cycle power plant. The obtained results are compared to other commonly applied approaches for feature extraction and signal processing, which include dimensionality reduction and manual feature selection.

The proposed approach demonstrates an excellent ability to extract the relevant features even in the presence of many non-informative signals, and learn them without any expert knowledge. In the different parts of the monitored signals, the proposed approach is able to detect the onset of the anomalous conditions, trigger the early warnings, and predict the general trends of degradation. The deep learning approach also demonstrates a very valuable ability to extract health indicators from high-dimensional condition-monitoring data that can be subsequently used to monitor the system health state and to predict the remaining useful life.