Anomaly detection of motors with Machine Learning and improving the Diagnostic Coverage

Presenter Name: Don Celestine Raj-Robert Bosch GmbH, Email ID : BrittoJosephSagayaraj.DonCelestineRa@in.bosch.com , Dinesh Babu Dondapati- Robert Bosch GmbH, Email ID : Dondapati.DineshBabu@in.bosch.com

With the increasing complexity in automotive hardware and software, functional safety is not only required to detect faults and move the system to safe state, but also to predict the faults in advance and warn the driver to avoid mishaps, accidents and reduce the cost of replacement of components during maintenance. This paper explains the prediction of faults in motor, which is the fundamental component of many systems in the automotive of the future. This paper explicitly focuses on two machine learning techniques to predict the anomalies in motor, Principal Component Analysis (PCA) and deep learning technique Autoencoders (State of the art Neural Networks).The primary data for analysis consists of a multivariate data that includes input currents, voltages, temperature of motor, vibration of motor and other parameters. To simplify the complexity of the high dimensional primary data and to understand the relation between each variable, PCA or Autoencoders are used to shrink the high dimensional data into two- or three-dimensional variable without much of a data loss and efficient compression. The algorithm takes care of the dimensionality reduction, feature selection and feature extraction as well. This is an unsupervised learning.

A quantitative analysis of the collected data is performed for the detection of inherent anomalies. The methodology used in this paper aims to use the difference in the data distribution of a normal working motor and a motor reaching failure. This difference of distance between the distribution is then used to find the failure by comparing it with the threshold for detecting faults, which can be set by injecting faults in motor or taking data from an existing erroneous motor. Fault injection in motor can be used as test data to find the accuracy of the machine learning model and to optimize the model by reducing the false negative situation.

Machine learning techniques are primarily employed to identify patterns in motor data and to extract information from the data. This methodology could be used to predict failure before its occurrence. This would considerably reduce the cost of maintenance and repair and significantly improve the diagnostic coverage in software.

Keywords – Functional safety, machine learning, diagnostic coverage, maintenance, motor faults, predictive failure