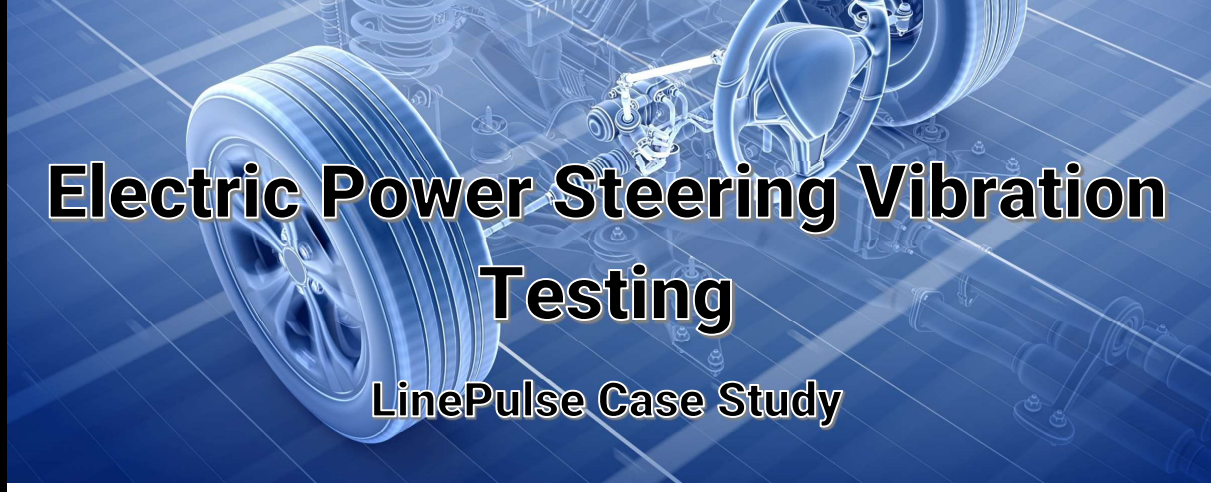

Electric Power Steering Vibration Testing

LinePulse Case Study

Objectives

- Improve EOL testing for electric power steering systems to catch more defects and reduce warranties in the field
- Identify failing units with 0% false negative rate and <1% false positive rate

Challenges

- Client required performance comparable or better than human inspectors
- Models were trained exclusively on data from normal (i.e., non-defective) systems
- Each system was subjected to vibration testing 8 times, with signal data collected from three dimensions via four different sensors, for a total of 96 signals per unit

Results

- Acerta's models successfully identified 27 failed systems from a training set of over 700
- Classification model achieved almost 100% accuracy, with a false negative rate of 0% and false positive rate of <1%

Learn more at:
https://acerta.ca

Background

A leading Tier-1 supplier of driveline components was looking to improve its end-of-line (EOL) testing for electric power steering systems. The company's goals were to reduce warranties by identifying more defective systems and replace their manual EOL test with an automated solution. The existing EOL regime used data gathered from four vibration sensors over the course of 8 tests, for a total of 96 signals per unit tested, with the results needing to be evaluated manually by experts.

The Problem

The client requested a machine learning model that would perform as well or better than its human EOL testers, which meant a false negative rate of 0% and a false positive rate of <1%. Acerta's training dataset consisted of roughly 700 electric power steering systems. Our data scientists used 5-fold and 10-fold cross-validation plus 27 failed units to test their classification model.

Solution Process

Acerta's team began by gathering information about the client's manufacturing and data collection process, which informed our intelligent feature engineering. The client had already been applying signal processing to its EOL data, but Acerta's data scientists augmented this approach with machine learning. Because the client already had a metric for success—i.e., an EOL test that would yield no false negatives and very few false positives—our engineers were able to build a model with that goal in mind.

Moreover, because the project involved analyzing vibration data (one of Acerta's specialities), our data scientists were able to leverage their previous experience with using vibrations to predict failures in gearboxes. Consequently, Acerta was able to complete the project more quickly by selecting from among the model types that had proven to be most successful at this task and reconfiguring them, rather than starting from a blank slate.

Results

Acerta created and deployed a classification model for EOL testing of electric power steering systems with almost 100% accuracy. We achieved the client's objective of a 0% false negative rate and <1% false positive rate, resulting in an automated EOL test that performed comparably to (or possibly even better than) the client's human testers.

This demonstrated Acerta's facility with vibration data as well as the continuous improvement of our machine learning models: our data scientists were able to take the insights and experience from one application—using vibration data to predict gearbox failures—and apply them to a similar but still novel one: using NVH data to predict electric power steering system failures