# IDENTIFICATION OF FAULTY TRANSMISSIONS AT END-OF-LINE USING ABNORMALITY SCORE

## Acerta LinePulse™ Case Study

Acerta
AI-Powered Machine Analytics

## OBJECTIVES

- Deliver model for unit abnormality score
- Identify 4 failed units from batch of 50

## CHALLENGE

- Learn from only 100 examples of passed EOL tests
- No failed units for models to learn from
- Real-time analysis required

## RESULTS

- Potential reduction of up to 30% in warranty costs
- Accelerated root-cause analysis with indication of abnormal signals
- Model ranked 4 failed transmissions in top 5 abnormal units out of 50

## CONTACT ACERTA


info@acerta.ca
+1 (416) 992-6731
http://acerta.ca
@AcertaAnalytics
Acerta Analytics Solutions
30 Duke Street West,
Kitchener, ON, Canada


## BACKGROUND

A leading Tier-1 manufacturer was looking to minimize in-market complaints by better detecting flaws in transmissions before they are shipped, using end-of-line (EOL) test data. The EOL test consists of 100+ steps, covering a variety of performance-based assessments about the quality of the assembly. Different measurements are collected at each test step, and the data is analyzed by an SPC-based program. The program analyzes only 10% of the total data being collected from each unit, and if a potential failure is detected, an engineer manually inspects all of the data from that unit.

## THE PROBLEM

Acerta was requested to deliver a model that automatically assigns an abnormality score to each newly tested transmission at EOL. The score would be evaluated by applying it to a dataset of 50 units out of which 4 are faulty.

The abnormality score will provide engineers with an indication of unit quality, allowing them to reduce the number of defective units not being flagged during EOL testing.

In order to test the ability of the software to extract valuable insight from limited data, the client provided data samples from only 100 units. The samples included only units that passed the existing EOL test and none that failed.

## SOLUTION PROCESS

Acerta began by gathering information about the client's manufacturing and data collection processes. This information allowed Acerta's data scientists to perform intelligent feature engineering, considering features ranging from standard moments to more advanced non-polynomial features that have been beneficial in similar use cases in the past. In addition, and after preliminary analysis of the data itself, Acerta's data scientists conducted a machine-learning-guided feature reduction, dropping features that had little or no value to the scoring algorithm.

Using unsupervised ensemble machine learning methods, Acerta produced the requested model that provided an abnormality score for transmissions at EOL. The score considered the expected behavior in each test step and across several steps simultaneously, and was calculated using the reconstruction error of different models in the ensemble. The abnormality score was then used to map out transmissions from the test dataset, and identify the "least explainable" portions of the data.

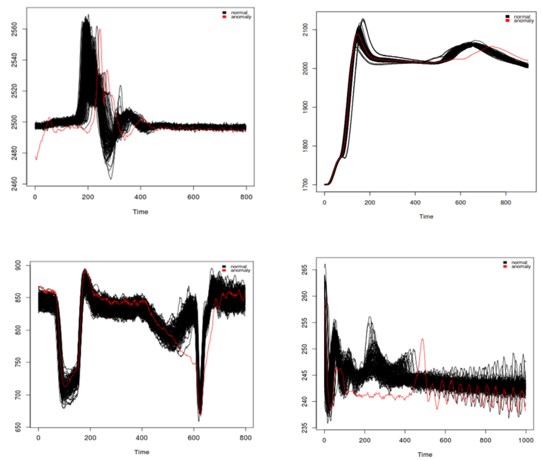

**Figure**: Each chart is an aggregation of the same specific signal as collected by all units during their EOL test. The signal from the failed unit, as identified by Acerat's platform, is marked in red.

## RESULTS

By using only a small unlabeled dataset of 100 transmissions, Acerta trained and delivered a model that produces an abnormality score for each new tested transmission. The model uses data from multiple test steps simultaneously, and identifies the signals that most contributed to the abnormality score. In one instance, Acerta's model showed a causality between pressure delays and rotation delays in a transmission. Detecting the specific signal relationships that led to the failure allowed engineers to significantly accelerate the diagnosis of the issue.

With this model, Acerta proved its ability to provide multi-signal failure detection, which cannot be done by the existing threshold-based program. As can be seen in the charts above, there is no clear threshold that was crossed (no extreme value) that could have triggered an alert from the existing testing program. However, a subtle deviation from normal signal behavior was automatically picked up by Acerta's model. The model pointed to the anomalous region within the trace, and cross-correlated the abnormal region with other signals from the same transmission to get a higher confidence score on its reporting.

When inspecting transmissions that had passed the client's EOL test but still received a high abnormality score from Acerta's models, the client reported that these units were indeed different, but had passed the existing EOL test.