

## Steering Misalignment & Loose Suspension

### AutoPulse Case Study

#### Objectives

- Demonstrate viability of predictive maintenance for on-road vehicles
- Detect two failure modes—steering misalignment and loose suspension—before they impact user experience

#### Challenges

- Client data was unlabeled, distributed across the enterprise, and independently maintained by separate divisions
- Failure modes constituted less than 0.1% of the available data

#### Results

- Acerta's models detected loose suspension at an accuracy rate of 95.8% and steering misalignment at an accuracy rate of 100%
- Acerta is continuing to work with the client to deploy the models to on-road vehicles and develop additional predictive models targeting other failure modes

#### Background

A leading Japanese OEM was looking to bring predictive maintenance to on-road vehicles. The company was already collecting electronic control unit (ECU) data through connected vehicles and via on-board diagnostic (OBD) ports. The OEM partnered with Acerta to explore the feasibility of using this data with Acerta's AutoPulse platform to predict vehicle failures. As a first step, both parties agreed to focus on detecting two failure modes—steering misalignment and loose suspension, particularly in the ball joints—with the aim of expanding to additional failure modes and real-time applications in the future.

#### The Problem

The client had been collecting on-road vehicle data for internal purposes and was seeking to extract more value from it. The company wanted to use on-road data to identify vehicle failures before they impacted driving experience, which is especially challenging. This data was distributed across the client's entire enterprise and maintained independently by separate divisions. In addition, the targeted failure modes constituted less than 0.1% of the available data.

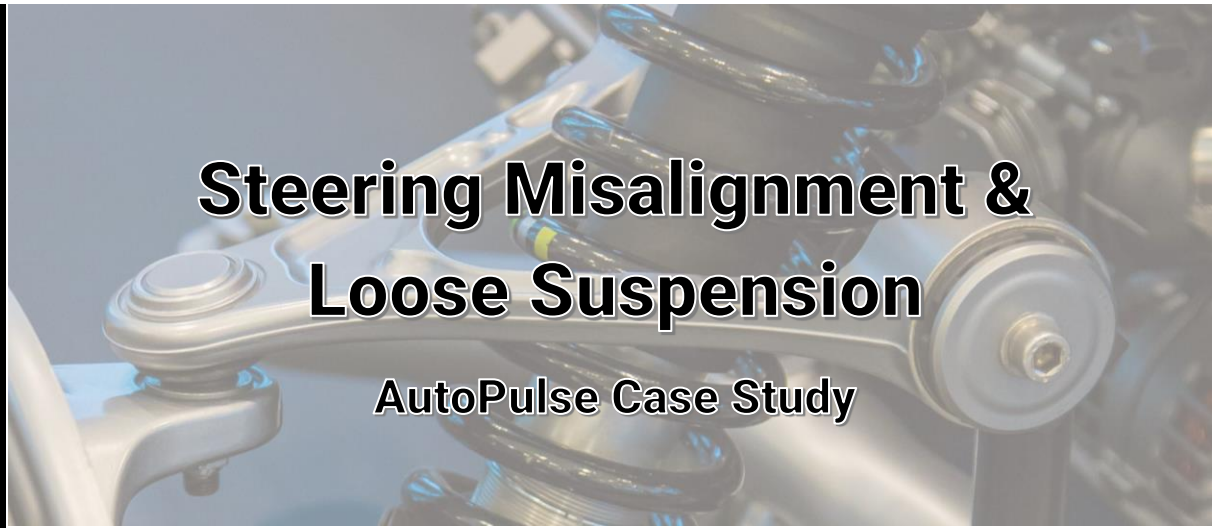
#### Solution Process

The first step was for Acerta's data engineers to collect, cleanse and unify the data from client's various divisions. Since it had been collected from different vehicle models and for different purposes, the data needed to be cleansed and subsequently transformed to build a single, unified dataset that could be loaded into AutoPulse via Acerta's data governance framework. Our data scientists used sanity-checking algorithms to eliminate any signals which were inconsistent, did not conform to vehicle dynamics, or lacked sufficient informational content.

Due to a lack of suspension failures in the data, Acerta generated simulated failures in order to ensure data diversity and thereby prevent models from overfitting. This involved identifying the subset of signals that would be altered by such a failure, determined through a combination of data analysis and domain knowledge.

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#### Solution Process (cont.)

By producing a slight difference in the speed of the affected wheel during straightaway driving, Acerta was able to realistically simulate a loose suspension issue for that wheel.

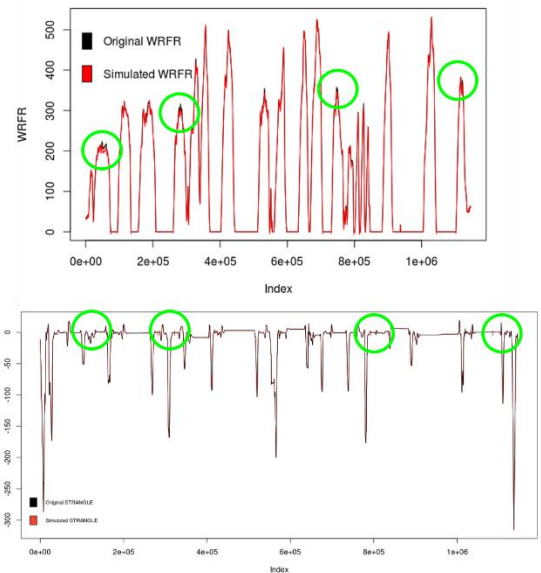
Finally, Acerta applied machine learning models to the dataset via AutoPulse. This involved training the models only on normal (i.e., non-failure) data so that they could learn the normal relationships between signals. Afterwards, the models were tested on unseen data (including normal, and simulated failure data).

As a result, AutoPulse was able to detect vehicle failures from on-road data by identifying the abnormal signals which predicted them.

#### Results

AutoPulse successfully detected both failure modes, with an accuracy rate of 95.8% for loose suspension and 100% for steering misalignment. In addition, the incorporation of simulated data into the dataset ensured that Acerta's models were scalable across vehicle types and driving conditions, and deployable in real-time.

Acerta is continuing to work with the client on deploying AutoPulse for additional vehicle components and other failure modes. Expanding their predictive modelling capabilities will enable the client to provide its customers with a comprehensive predictive maintenance and safety solution.



Examples of simulated failures based on changes in RPM (top) and steering angle (bottom).