Master's Thesis

At SJ Vehicle Department

Background

SJ is currently installing a new tool for remote diagnostics for a major part of SJs fleets (36 X2000, 20 SJ 3000, 42 Double decker). The measurement data and fault codes from the train control system are transmitted and are available in our remote diagnostic system (delivered by Trimble/Nexala) for operative use. It is also stored in a Big data platform (Azure) together with other business data.

Currently we collect ca 4000 signals per second for the described fleets. At the end of the installation project, there will be a possibility to collect up to 20 000 signals per second.

There are different types of signals transmitted from the vehicles, such as:

- Status (for example door open, door closed)
- Measurements (for example train speed, compressor temperature)
- Fault codes (for example measurements out of range, short circuits, sensor errors)
- Counters (for example number of door openings)
- Infrastructure sensors (for example measuring vibration and temperature of wheels and bearings)
- Geographic information (for example where faults occur most frequently)

Examples of business data:

- Effects in traffic (for example delays, stopping failures)
- Failure frequencies
- Performed preventive maintenance
- Performed corrective maintenance
- Maintenance costs
- Material costs
- Material consumption
- Measured values
- Etc.

By combining transmitted data with other business data we aim at increasing the level of condition based maintenance on our fleets by identifying maintenance needs before the failure has had an operational effect, in order to:

- Increase punctuality
- Increase availability
- Decrease maintenance costs

Objective

The way forward requires a structured approach and will also include new ways of working as well as new competence areas. It includes the possibility to offer master thesis in one or several areas such as:

- Exploring suitable mathematical model to apply to the deterioration of a system/component based on a specific set of data in order to predict the appropriate time to perform preventive or corrective maintenance. Example of areas could be:
    - Exterior or interior doors, analysing parameters such as opening and closing times, door motor current patterns, number of door cycles, and combining the data with business data (failures / failure types and material consumption).
    - Brake system, combining brake pad and brake disc consumption (as well as information on damages) with brake pipe pressure in order to find an appropriate maintenance set up in order to minimize cost.
    - Other systems with high maintenance needs such as HVAC, Sanitary, Compressors, Tilt.
- Apply appropriate machine learning method for a specific set of data and problem, to learn about dependencies between different parameters, such as:
    - Dependencies between signals from any of the areas listed above and failure information from SJ's Asset Management system in order to determine the true cause of a failure.
    - Among large amount of data such as signals and SJ's Asset Management system identify unusual behavior for a component in order to perform maintenance before failure.

The definition of the master thesis is elaborated in close connection with the advisor at SJ and the tutor at KTH.

Application

M.Sc.Student in: Applied and Computational Mathematics and Machine Learning
Number of students: 1-2
Start of work: January 2020 – 30hp
Language of work: Swedish or English

For more information, contact Eveline Haugaard, Management Trainee- Eveline.Haugaard@sj.se