



Machine learning methods for vehicle predictive maintenance using off-board and on-board data

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Abstract

Vehicle uptime is getting increasingly important as the transport solutions become more complex and the transport industry seeks new ways of being competitive. Traditional Fleet Management Systems are gradually extended with new features to improve reliability, such as better maintenance planning. Typical diagnostic and predictive maintenance methods require extensive experimentation and modelling during development. This is unfeasible if the complete vehicle is addressed as it would require too much engineering resources.

This thesis investigates unsupervised and supervised methods for predicting vehicle maintenance. The methods are data driven and use extensive amounts of data, either streamed, on-board data or historic and aggregated data from off-board databases. The methods rely on a telematics gateway that enables vehicles to communicate with a back-office system. Data representations, either aggregations or models, are sent wirelessly to an off-board system which analyses the data for deviations. These are later associated to the repair history and form a knowledge base that can be used to predict upcoming failures on other vehicles that show the same deviations.

The thesis further investigates different ways of doing data representations and deviation detection. The first one presented, COSMO, is an unsupervised and self-organised approach demonstrated on a fleet of city buses. It automatically comes up with the most interesting on-board data representations and uses a consensus based approach to isolate the deviating vehicle. The second approach outlined is a supervised classification based on earlier collected and aggregated vehicle statistics in which the repair history is used to label the usage statistics. A classifier is trained to learn patterns in the usage data that precede specific repairs and thus can be used to predict vehicle maintenance. This method is demonstrated for failures of the vehicle air compressor and based on AB Volvo's database of vehicle usage statistics.

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