Contribution ID: **136** Type: **not specified**

A Framework for Degradation Modelling of Linear Assets - A Railway Track Case Study

Linear assets such as roads, pipelines, and railways are crucial components of a society's infrastructure, and their proper maintenance is critical. These assets have defined beginnings and ends but exhibit specific characteristics with branching and heterogenous segmentation. Their sizes require condition monitoring to be performed using special measurement devices such as measurement cars or trollies measuring the condition. Such measurements produce data which, in turn, often poses specific challenges. The data often require non-linear models, are non-stationary and are usually noisy. The noise stems from their infrequent inspections, often obtained with different instruments inspection. The data could include seasonality components, and the inspections could be obtained at irregular intervals at varying environmental conditions which hampers modelling. Consequently, modelling degradation for condition-based maintenance is difficult, potentially leading to unnecessary maintenance or increased risks. This study explores different modelling approaches by applying data-driven degradation modelling techniques to a railway track section in Northern Sweden.
The study presents a framework for data-driven modelling of linear asset degradation. We evaluate the strengths, limitations, and assumptions of four methods: linear regression, random forest, support vector machine, and the Wiener process model. Additionally, we explore using hyperparameter tuning techniques to enhance predictive performance. Furthermore, we assess each model's performance and computational efficiency within our specific case environment. These results provide practical guidelines for professionals and contribute to the ongoing scientific discussion on applying data-driven approaches in maintenance.

Keywords

Framework, prognostics, maintenance

Classification

Both methodology and application

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Session Classification: CONTRIBUTED Data Analytics

Track Classification: Data analytics