Feasibility Study for Predictive Production Line Maintenance

Graduate

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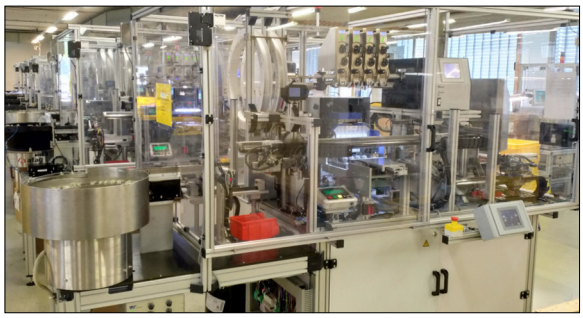
Introduction: The topic of Predictive Maintenance of production lines has gained relevance and attention in recent years. More and more frequently, production lines are equipped with a wide variety of sensors to record process and plant data. These data can subsequently be analyzed and used for various needs. The present work deals with the question whether first steps towards Predictive Maintenance can be made with the existing data of the production line JEEB.

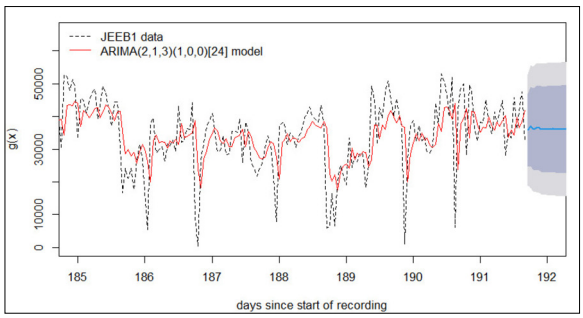
Approach: The chosen approach was strongly oriented towards the CRISP-DM model. This allows the individual work steps to be designed flexibly and dynamically. First, the data of the production lines, which were stored in an SQL database, were prepared for the data analysis. In the explorative data analysis, the individual measured values were examined over time and any weaknesses in their distribution were identified. Subsequently, a detailed time series analysis of the number of coils produced was performed and a prediction was calculated based on this model. Finally, the focus was on calculating a prediction of machine downtime. For this purpose different Supervised Learning algorithms like Random Forest or Support Vector Machine were implemented and tested.

Result: The distribution analysis showed that the data is in most cases not normally distributed and partly has a serial correlation. Modeling on these data must therefore be tested for statistical stability. The major findings of production process analysis showed that the cpk value is rather low on some measurement values when producing article group 8995 and the waste can not be predicted by any measurement. Furthermore, it could be shown that the number of coils produced can be modeled and a forecast can be computed. The residual analysis showed that the calculation is statistically stable. One can use these findings to implement the forecast as a KPI in the product management system. The causal relationship of the generated error messages is not conclusively secured due to programming reasons as well as due to the resolution of the data collection. Thus, the work focused on the detection of a machine breakdown independent of the exact error. Several Machine Learning algorithms were implemented to predict a machine breakdown based on the data. The positive predicted value (PPV) of all applied methods is too low in order to implement Predictive Maintenance with the given data. Nevertheless, it could be shown that the combination of classifiers can significantly improve the prediction. Therefore, other measured values are necessary to determine the state of a production line.

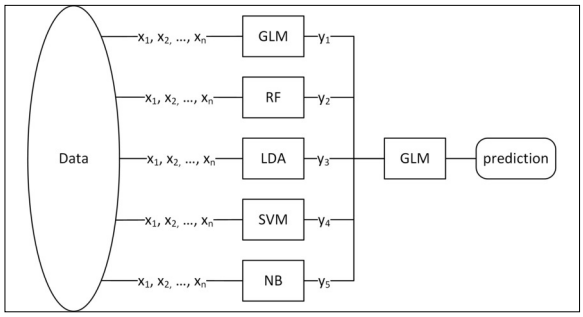
Production lines JEEB.
Own presentment



ARIMA forecast of the transformed time series of good parts.
Own presentment



Stacked Ensemble principle.
Own presentment



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Subject Area
Innovation in Products, Processes and Materials - Business Engineering and Productions

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