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Feature Selection Approach for the Classification of Hydraulic Leakages in Hydraulic Final Inspection using Machine Learning

Authors : Christian Neunzig, Simon Fahle, Jürgen Schulz, Matthias Möller, Bernd Kuhlenkötter

Abstract : Manufacturing companies are facing global competition and enormous cost pressure. The use of machine learning applications can help reduce production costs and create added value. Predictive quality enables the securing of product quality through data-supported predictions using machine learning models as a basis for decisions on test results. Furthermore, machine learning methods are able to process large amounts of data, deal with unfavourable row-column ratios and detect dependencies between the covariates and the given target as well as assess the multidimensional influence of all input variables on the target. Real production data are often subject to highly fluctuating boundary conditions and unbalanced data sets. Changes in production data manifest themselves in trends, systematic shifts, and seasonal effects. Thus, Machine learning applications require intensive pre-processing and feature selection. Data preprocessing includes rule-based data cleaning, the application of dimensionality reduction techniques, and the identification of comparable data subsets. Within the used real data set of Bosch hydraulic valves, the comparability of the same production conditions in the production of hydraulic valves within certain time periods can be identified by applying the concept drift method. Furthermore, a classification model is developed to evaluate the feature importance in different subsets within the identified time periods. By selecting comparable and stable features, the number of features used can be significantly reduced without a strong decrease in predictive power. The use of cross-process production data along the value chain of hydraulic valves is a promising approach to predict the quality characteristics of workpieces. In this research, the ada boosting classifier is used to predict the leakage of hydraulic valves based on geometric gauge blocks from machining, mating data from the assembly, and hydraulic measurement data from end-of-line testing. In addition, the most suitable methods are selected and accurate quality predictions are achieved.

Keywords : classification, achine learning, predictive quality, feature selection
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