Identifying Product and Process State Drivers in Manufacturing Systems Using Supervised Machine Learning

Abstract
In the dissertation, the product state concept has been developed as a method to describe comprehensively a product by its states along a complete manufacturing programme. A core mechanism of this concept is the description of the product state by a set of state characteristics. The fundamental question of how to identify this set of state characteristics to allow a comprehensive description of the products state, set the foundation for the conducted research. A major aspect within the work was found to be process intra- and inter-relations between state characteristics, later referred to as state drivers. Today, most manufacturing programmes lack sufficient knowledge and transparency with regard to process intra- and interrelations making a complete modeling of the system unrealistic. In order to be able to incorporate this crucial element in the analysis, supervised machine learning was employed in form of SVM (Support Vector Machine) based feature ranking to incorporate successfully implicit process intra- and inter-relations of the manufacturing programme. The evaluation of the research was conducted by using three different scenarios from distinctive manufacturing domains based on ‘real world’ data sets. The first scenario represented the mechanical manufacturing domain, blade manufacturing, with a case provided by Rolls-Royce. The second scenario focused on the chemical manufacturing domain and the third scenario resembled a semiconductor manufacturing case. The purpose of choosing three different scenarios was to highlight the general applicability of the developed concept. The evaluation confirmed that it is possible to incorporate implicit process intra- and inter-relations on process as well as programme level as required by the product state concept through applying SVM based feature ranking. Even so the results confirm that the approach successfully utilizes the implicit process intra- and inter-relations between states and state characteristics, at this point the relations are not provided as an explicit output of the analysis.

Autor
Wuest, Thorsten

Institution
Bremer Institut für Produktion und Logistik (BIBA), Bremen, DE; Department of Production Engineering, Universität Bremen, DE