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Artificial Neural Network Model Based Setup Period Estimation for Polymer Cutting

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Abstract : The paper presents the results and industrial applications in the production setup period estimation based on industrial data inherited from the field of polymer cutting. The literature of polymer cutting is very limited considering the number of publications. The first polymer cutting machine is known since the second half of the 20th century; however, the production of polymer parts with this kind of technology is still a challenging research topic. The products of the applying industrial partner must met high technical requirements, as they are used in medical, measurement instrumentation and painting industry branches. Typically, 20% of these parts are new work, which means every five years almost the entire product portfolio is replaced in their low series manufacturing environment. Consequently, it requires a flexible production system, where the estimation of the frequent setup periods' lengths is one of the key success factors. In the investigation, several (input) parameters have been studied and grouped to create an adequate training information set for an artificial neural network as a base for the estimation of the individual setup periods. In the first group, product information is collected such as the product name and number of items. The second group contains material data like material type and colour. In the third group, surface quality and tolerance information are collected including the finest surface and tightest (or narrowest) tolerance. The fourth group contains the setup data like machine type and work shift. One source of these parameters is the Manufacturing Execution System (MES) but some data were also collected from Computer Aided Design (CAD) drawings. The number of the applied tools is one of the key factors on which the industrial partners’ estimations were based previously. The artificial neural network model was trained on several thousands of real industrial data. The mean estimation accuracy of the setup periods' lengths was improved by 30%, and in the same time the deviation of the prognosis was also improved by 50%. Furthermore, an investigation on the mentioned parameter groups considering the manufacturing order was also researched. The paper also highlights the manufacturing introduction experiences and further improvements of the proposed methods, both on the shop floor and on the quotation preparation fields. Every week more than 100 real industrial setup events are given and the related data are collected.

Keywords : artificial neural network, low series manufacturing, polymer cutting, setup period estimation
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