Computational Intelligence for Process Optimization in Casting Industry

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Abstract

The manufacturing process optimization problems are complex owing to the non-linear relationships and interactions may occur among process factors. Traditionally, engineers commonly employ the experimental design to resolve the problem. However, the experimental method has some limitations in practice. This study applies computational intelligence approaches to solve the process optimization problem. A real case study of a casting company located in Taiwan is demonstrated. In this case, the process output, tensile strength, is the larger the better. First, engineers from different areas of expertise formed a team and field-based data were collected for process improvement. Based on engineering knowledge, the project team identified some possible factors that may affect the tensile strength. Then, feature selection techniques, including neural network, regression analysis, support vector machine, random forest, and rough set theory were implemented to screen out the important process factors that affect the process output. The final key process factors for further study were selected by the majority rule. Next, the team utilized these key process factors to predict the tensile strength by using the backpropagation neural network. The trained network, describing the relationship between the process factors and the process output, was employed as the fitness function in the genetic algorithm. The control factor values were then transformed into a chromosome to represent the potential solution. By setting appropriate parameters, genetic algorithm was used to optimize the solution. In this study genetic algorithm was executed in several runs and the best solution from each run was saved. The optimal solution with the highest tensile strength was selected from these possible solutions. By using this optimal solution in the manufacturing process, the case company can significantly improve the product quality and reduce manufacturing costs.

Keywords
Computational intelligence, feature selection, neural network, genetic algorithm, casting industry

Biographies

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