GENETIC BASED APPROACH TO PREDICTING THE ELONGATION OF DRAWN ALLOY

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Abstract
This paper describes a genetic based approach for the modelling of elongation in cold drawn copper alloy. Genetic programming is one of the most general genetic based methods and was used in our research. It is an automated evolutionary computation method for creating a working computer programme from a problem’s high-level statement. Genetic programming does this by breeding a population of computer programmes genetically using the principles of Darwinian’s natural selection and biologically inspired operations. In our research, material was formed by drawing using different process parameters and then determining elongation of the specimens. On the basis of a training data set, various different genetic models for the elongation distribution were developed during simulated evolution. The accuracies of the best models were proved by a testing data set and comparison between the genetic and regression models was carried out.

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Key Words: Genetic Programming, Prediction, Metal Forming, Elongation, Copper Alloy

1. INTRODUCTION

Many modelling methods for predicting different dependent variables have been developed to reduce the costs of the experiments. Traditional methods often employed to solve real complex problems tend to inhibit elaborate explorations of the search space. In most conventional deterministic modelling methods, such as regression analysis, a prediction model is determined in advance. Because of the pre-specified shape and size of the model, the obtained model is often incapable of capturing complex relationships between influencing parameters. It is important that the independent input variables influence on the dependent output variables and, consequently, on the product quality which has been already been examined in the early stages of a metal forming process.

Evolutionary computation (EC) is generating considerable interest for solving real engineering problems. They are proving robust in delivering global optimal solutions and helping to resolve those limitations encountered in traditional methods. EC harnesses the power of natural selection to turn computers into optimization tools. This is very applicable to different problems in the manufacturing industry. One of most important EC methods is genetic programming (GP) which is, similarly to a genetic algorithm, an evolutionary computation method for imitating the biological evolution of living organisms.

In [1] two models have been developed for roughness modelling: a regression model and a model based on neural networks, with better fitness of the neural model. In [2] Barkallah et al. proposed a three-dimensional statistical approach for determining the manufacturing tolerances based on the components of the small displacements tensors which were considered as random variables. It was found out that the difference between simulation and experiments was reasonably small. Several other researches have been carried out using statistical analysis [3, 4]. In [5] forming process have been investigated experimentally and modelled using generalized GMDH-type which is a group method of data handling neural networks. It was also demonstrated that singular value decomposition can be effectively used to find the vector of coefficients of quadratic sub-expressions embodied in such GMDH-type


