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Research on Stamping Spring-back Prediction for Car Body Panel Based on BP Neural Network

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Abstract. On the basis of orthogonal test analysis of variance, BP neural network is used to forecast quantitatively the stamping spring-back of front panel of a car body, namely the engine hood, under the conditions of different stamping parameters. Firstly, BP neural network prediction model is established and sample training is done in Matlab. Then, the spring-back prediction using BP neural network and the result of spring-back simulation using Dsiformer is compared to verify the precision and stability of the prediction model. Lastly, modifications is made to the BP neural network according to practical stamping parameters and an efficient BP neural network model is established. Using this model, stamping spring-back prediction for the front panel of a car body is made. The spring-back prediction could then be used for spring-back compensation in the mould design of the front panel.

Introduction

Compared with ordinary stamping parts, car body panel is characteristic of thin material, complex shape, multi-space surface, big size and high surface quality requirement. The key technology of the stamping process of car body lies in the possibility and reliability of drawing. Because traditional "trial and error" method will result in substantial waste of resources, it can't meet the requirements for increasingly shorter cycle of product upgrade. Metal forming simulation technology can then be used to improve this phenomenon [1]. Auto body panel stamping simulation allows designers to forecast, in the preparatory stage of production, problems that may arise in the metal forming, and then determine the technical parameters required for forming, validating and optimizing the mould design. Therefore, the use of computer simulation has become a powerful means to study on the performance of sheet metal forming.

In previously published papers, the authors of this paper presented results of stamping simulation of the front panel of a car body to analyze the frequently emerged forming defects such as breakdown, wrinkling and spring-back under conditions of different stamping parameters. In the papers, by using orthogonal test analysis method, we made repeated conditions to analyze the impact of the stamping parameters such as blank holder force, draw bead and coefficient of friction on stamping spring-back [2]. Through orthogonal test analysis, it is found that with the increase of blank holder force, the spring-back of the front panel decreases correspondingly, and when the lubrication is bad, that is, when the friction coefficient is big, the spring-back is small and that the variations of the thickness of the panel have a certain impact on the spring-back of the panel, which is characteristic of tensile and local deformation, but the impact mode is complex. Orthogonal test analysis of variance can be used to make qualitative analysis of the impact relationship between the factors and results of the test, but it can only be used to make qualitative prediction of the test results, it can't be used to make more accurate quantitative prediction.

In order to quantitatively predict the spring-back of the car body panel in the stamping process, BP neural network is used. By using reasonable set of parameters and mould annotations according to the prediction results, stamping mould design of the car body panel is presented and corresponding tests made to verify the accuracy and feasibility of the spring-back prediction in this paper.

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