Comparison of the grey theory with neural network in the rigidity prediction of linear motion guide

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Abstract: The purpose of this paper is to compare the prediction models constructed through neural network and grey theory, and to apply the prediction model established to study of correlation between linear motion guide rigidity under the stress of tension and compression. Strain data of tension and compression are simultaneously obtained by the computer that is linked with the Universal testing machine and translated into rigidity values through the formula of $F = k\delta$. Through this study we can understand the differences in prediction of rigidity between neural network and grey theory. Experiment results will serve as reference for manufacturers and users, with the hope that based on fewer measurement data testing time can be reduced and the outcome can be more accurately predicted. Based on fewer measurement data, the outcome can be more accurately predicted, and that with a nondestructive test can accurately predict the rigidity of the linear motion guide. The outcome indicates that the prediction model established through neural network is superior to the prediction model established through the grey theory, and that the neural network model can accurately predict the result.

Key-words: grey prediction model；rigidity；linear motion guide；neural network；tension；compression

1. Introduction

The linear motion guide can be seen as a special bearing. It is not a regular rotation bearing, but a automatic processing equipment, CNC machine tools, automated robot and nano-micro-processing device pertinent to linear motion. Any automatic equipment related to linear motion needs this important part. It employs balls as the transmission platform between the rail and the block to engage in unlimited cycles of motions. The block is confined to the rail so the load platform can engage in high-speed, high-precision linear motions along the rail. Its major components include rail, block, end plate, ball and retainer (as shown in Fig.1). Normally the friction coefficient of rolling is only 2% of that of sliding. The ratio between the strain