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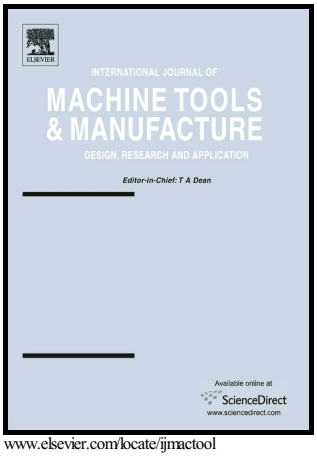

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Method for identifying feed-drive system dynamic properties using a motor current

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Abstract: The dynamics of a machine tool ball screw is an important topic in high-precision machining. Capturing the axial and torsional dynamics of the ball screw has an important guiding significance to the stable processing of the machine tool. The traditional methods mainly involve a mounted sensor or direct embedment into the structure and hybrid finite element methods (FEMs), which are inconvenient. The FEM accuracy is limited by the accuracy of the model. This paper reports that feed-drive system vibration is excited by the interactive impact of a screw, ball, and nut, whose interaction is the core of the feed-drive system dynamics. Under the action of current, the ball screw serves as the transmission component of the executive component to control the working condition of the sliding table. This paper proposes a new method that uses the inertia force sequence caused by random idle running of the sliding table to identify the natural frequency of a feed-drive system based on the feed motor current response. First, the corresponding relationship between the current and the vibration of the feed-drive system is studied. The accuracy of the new method based on the current response is analysed by the experiment, which is performed to identify the natural frequency of the feed-drive system. Then, the incentive region is changed to study the identification effect under different interactive impact conditions, where the contact condition of the ball screw is different.

Keywords: Ball screw, Machine tool, Natural frequency, Motor current

1. Introduction

The geometrical and dimensional accuracies of machined parts mainly depend on the dynamics of the machine tool. An important method of optimizing the product design and manufacturing process is to analyse the dynamic behaviour of machine tools. Generally, there are two methods of estimating the dynamic parameters of an entire machine tool structure. One method is based on computer-aided engineering. In a review, Altintas et al. [1] used finite elements under the theory of analysis to obtain