

Cutting Force Monitoring based on the Frequency Analysis

of Feed Motor Torques

Abstract

Cutting force monitoring without any additional sensors will be an important technology to achieve autonomous machine tools which can control the cutting conditions and failure detections. The purpose of this study is to develop a cutting force estimation method based on servo information in ball screw drive machine tool. In this method, the cutting force is estimated by frequency analysis of servo motor torque of feed drive systems. A frequency component depended on the cutting force is extracted from the analyzed data, and the cutting force is estimated by inverse transformation from the frequency domain to time domain. The motor torque is strongly influenced by the friction force especially in case of the axis stopped. In the proposed method, the estimated cutting force is calibrated based on the identified friction force when the force is detected along the stopped axis. In order to confirm the effectiveness of the proposed method, actual cutting tests and simulations are carried out. As the results, it is confirmed that the proposed method can estimated cutting forces accurately in case of the cutting force becomes larger than the friction force of stopped axis.