Electromagnetic Actuator for Determining Frequency Response Functions of Dynamic Modal Testing On Milling Tool

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ABSTRACT
Machine tools are the main driving forces of industrialization of a country. However, poor machinability because of chatter vibration results in poor surface quality, excessive noise, and reduced material removal rate. Modal testing is a useful method to investigate dynamic properties of a cutting tool system and improve material removal rate. However, at present, modal testing using impact hammer is limited by certain problems. This paper developed a non-contacting electromagnetic actuator (EMA) to determine frequency response functions (FRFs) under amplitude and speed dependencies of cutting milling tools. The geometry was designed using magnetic circuit analysis and generalized machined theory before finite element analysis was conducted using magnetostatic-ansys software. Next, EMA was used as a contacting and non-contacting exciter of a conventional milling machine to determine the FRFs and dynamic properties of milling tool with amplitude and speed dependencies including comparison with static FRFs. Subsequently, dynamic properties and FRFs are used to establish stability lobe diagram. Stability lobe diagram also shows an improvement of up to 5% of depth of cut at lower spindle speed. In conclusion, by generating force that applies to static and dynamic modal testing, an EMA can determine dynamic properties and stability lobe diagram for increasing material removal rate and production rate.

KEYWORDS: Tool chatter; Dynamic properties; Electromagnetic actuator; Modal testing; Finite element analysis; Stability lobe diagram

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