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A coupled dynamics, multiple degree of freedom process damping model, Part 2: Milling

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Abstract

Self-excited vibration, or chatter, is an important consideration in machining operations due to its direct influence on part quality, tool life, and machining cost. At low machining speeds, a phenomenon referred to as process damping enables stable cutting at higher depths of cut than predicted with traditional analytical models. This paper describes an analytical stability model for milling operations which includes a process damping force that depends on the surface normal velocity, depth of cut, cutting speed, and an empirical process damping coefficient. Model validation is completed using time domain simulation and milling experiments. The results indicate that the multiple degree of freedom model is able to predict the stability boundary using a single process damping coefficient.

Keywords

Machining; chatter; stability; process damping; simulation

Introduction

Process damping is a phenomenon that enables increased depths at cut at low cutting speeds in machining operations. When its effect is added to the analytical stability lobe diagram, a valuable predictive capability is afforded to process planners for *a priori* selection of machining

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