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Vibration aided tool wear estimation in a machining process

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ABSTRACT

Monitoring tool wear in machining processes is of high importance in many precise industrial applications. In this article, tool wear estimation is considered by the use of tool vibration signals. During a cutting process, tool acceleration signals are acquired by a 3D miniature accelerometer. Based on the dynamics of the tool/holder system that manifests itself in natural frequencies/modes, wear sensitive features are determined and derived from FS-TARMA model that can model the nonstationary signals. The important property of the feature which is a meter based on model poles (frequencies) is its independence from cutting conditions and workpiece type. Analysis of experimental results reveals that beam vibration changes from first bending mode in feed direction to second bending mode in main cutting direction and this phenomenon can be used for major flank wear estimation. The method obtained based on results of analysis can be used for development of an online real-time tool wear estimation algorithm in a turning process.