Procedia CIRP

2014

Indirect Model Based Estimation of Cutting Force and Tool Tip Vibrational Behavior in Milling Machines by Sensor Fusion

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Abstract:

Real time prediction of cutting tool condition and machined surface finish have been attractive research objectives over the last decades. However, providing practical and reliable solutions is still a demanding task for milling machine tools. One of the most challenging literature goals is to obtain a robust estimation of the cutting forces through indirect sensor measurements since many process and tool related quantities are indirectly linked to cutting forces. Another challenging issue in machining process monitoring and control is prediction of surface finish and quality. As the vibration plays a major role in the surface generation, this can be done by accurate prediction of the vibrational displacements at the tool tip during machining operation. In this paper, a novel model based estimation of cutting force and tool tip acceleration is designed and tested based on data fusion of different sensors measurements. In this context, two sensors (piezoelectric accelerometer and eddy-current displacement both mounted inside the spindle structure) have been utilized to acquire the experimental signals over a wide range of frequencies.

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Selection and peer-review under responsibility of the International Scientific Committee of "9th CIRP ICME Conference"