Journal of Sound and Vibration

2014

Efficient evaluation of process stability in milling with Spindle Speed Variation by using the Chebyshev Collocation Method

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Abstract: Chatter is a vibrational problem affecting machining operations, which may cause bad surface quality and damages to the machining system. In recent decades, several techniques for avoiding chatter onset were developed. Among other techniques, the continuous modulation of spindle speed during the cutting process (also called Spindle Speed Variation - SSV) has been demonstrated to be very effective for reducing the chance of chatter onset. However, spindle speed modulation parameters should be adequately chosen before machining, in order to effectively increase the material removal rate. In this perspective, chatter prediction algorithms play a crucial role, since they allow a preventive evaluation of process stability for any given spindle speed regime. State of the art algorithms for chatter prediction in milling with SSV are characterized by extremely long computation times, hindering their practical application in industry. In this paper, an innovative and fast algorithm for chatter prediction in milling with SSV, based on the Chebyshev Collocation Method, is presented. The algorithm was successfully compared with a state of the art algorithm - the Semi Discretization Method - in different experimental configurations and cutting conditions. The results showed that the new method is generally more accurate and from ten to one thousand times faster than the Semi Discretization Method.

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