9th CIRP International Workshop on Modeling of Machining Operations May 11-12, 2006, Bled, Slovenia

The Effect of Runout on the Chatter Frequencies of Milling Processes

T. Insperger[1], B.P. Mann[2], G. Stepan[1], B. Edes[2]
[1]Budapest University of Technolgy and Economics, Dept. of Applied Mechanics, 1521 Budapest, Hungary
[2]University of Missouri, Dept. of Mechanical & Aerospace Engineering, E3412 Lafferre Hall Columbia, MO 65211, USA
inspi@mm.bme.hu

Abstract

A mechanical model of a 2 DoF milling process with static and dynamic considerations for runout is presented. The corresponding mathematical model is a delay differential equation with periodic coefficients. A regenerative time delay - equal to the tooth passing period - is applied and the period of the periodic coefficients that account for the tool rotation are equal to the tool rotation period; that is, the principal period of the system is a multiple of the time delay as opposed to the typical modeling assumption (without runout) of the principal period being equivalent to the time delay. Stability analyses are performed and chatter frequencies are determined. It is shown that additional peaks arise in the chatter spectrum due to the runout. Stable machining, periodic chatter (associated with period doubling/flip bifurcation) and quasi-periodic chatter (associated with Hopf bifurcation) cases are investigated, the structure of the frequency peaks in the corresponding specta are explained.