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

Estimation of Cutter Eccentricity for Tool Condition Monitoring

Mathieu Ritou, Sebastien Garnier, Benoit Furet, Jean-Yves Hascoet
IRCCyN (Institut de Recherche en Communications et Cybernetique de Nantes, UMR CNRS 6597),
1 rue de la Noe, BP 92 101, 44 321 Nantes Cedex 03, France.
Ritou.Mathieu@irccyn.ec-nantes.fr

Abstract

A reliable Tool Condition Monitoring (TCM) system is needed for unmanned machining applications and could allow a higher degree of process automation, increasing productivity and reducing manufacturing costs. Indeed, machining disturbances such as collision, cutter breakage, excessive tool wear or chatter may still occur. Without reactions of a TCM system, it can result in catastrophic failures and damages to the machine tool and the workpiece, down times, and loss of productivity. Besides, if numerous false alarms are sounded, the TCM system will rapidly be switched off by the operator. Yet, there is a lack of reliable TCM solution for flexible manufacturing in milling. To tackle the problem of reliability, a versatile in-process monitoring system based on cutting forces measurement is suggested, where monitoring is stopped during transient cuttings. The radial cutter eccentricity of the teeth is estimated using cutting force signals and it is assumed to remain identical if no disturbance occurs. In this paper, resultant cutting forces are simulated under a wide range of cutting conditions, using a cutting force model which takes into account the cutter eccentricity. The method is verified when applied to the simulated cutting forces in order to estimate the cutter eccentricity. Then, the method is applied to cutting force signals measured during experiments carried out under a wide range of cutting conditions and where cutter eccentricity is know.