

An approach to monitoring the thermomechanical behavior of a spindle bearing system using acoustic emission (AE) energy

Abstract

Real time condition monitoring plays a key role in modern manufacturing processes. Critical processes, however, require systems capable of early detection and rapid adjustment of bearing conditions in order to ensure processing quality. Specifically, the spindle stiffness is significantly affected by the bearing contact pressure, which in turn is readily changed by thermal effects. A technique is proposed to monitor the spindle condition via acoustic emission (AE) signals. This method implements an analysis combining wavelet packet decomposition, Hilbert-Huang Transform, and screening processes (WPD-HHT) to extract the crucial characteristics from the measured signal to identify the running state of a spindle bearing. The implementation of the WPD-HHT envelope technique is also presented. Acoustic emission signals as well as the temperature growth measured from the spindle housing are used in the investigation. The results show that the proposed WPD-HHT and WPD-HHT envelope techniques enable the extraction of the most important signal features and their presentation in term of energy values. The displayed energy value is correlated to the preload changes since the temperature of the rolling bearing increases with AE energy.