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Development of a cutting edge temperature measurement of end mill tool by using infrared radiation technique

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ABSTRACT

This paper describes the development of cutting temperature measurement of end mill tool by using infrared radiation technique approach. Compared to conventional thermocouple technique, infrared radiation technique is an advance method of measuring temperature which featured high accuracy, high response rate, wide range of temperature scale detection and almost compatible with all materials used in the manufacturing industry. We measures the emission of infrared radiation from the source, which is cutting edge of tool by using photocells that contains InAs and InSb photovoltaic detectors. Photocells converts the infrared radiation to a voltage signal and then recorded by oscilloscope followed with a calibration with its corresponding temperature. This paper discussed about the calibration method, cutting experiment setup, the limit of infrared radiation level detected by photocells, signal correction of output signal, and relations of peak signal formation with rotation of end mill tool. The developed pyrometer is also capable to profile the cutting tool's rotation based on the movements of infrared radiation's emission at cutting tool's edge. The conclusion was that the measurement of cutting temperature of high speed machining by using infrared radiation technique is possible. The developed pyrometer are capable to detect temperature changes at a span of 0.01 ms.

Keywords: Pyrometer; end milling; infrared radiation; signal processing; cutting temperature.

INTRODUCTION

A machining process in manufacturing is one of the important process in product fabrication. The fabrication process requires removal of unwanted material from the workpiece to obtain a desired shape with high dimensional accuracy of the parts or products. High speed machining is used to produce a product that requires high surface integrity with excellent dimensional accuracy. Unfortunately, usage of high speed machining will cause high tool wear rate [1]. Tool wear affects the workpiece surface integrity. Main causes of tool wear are poor chip formation mechanism, poor coolant system, wrong cutting tool material for particular workpiece and wrong choice of cutting speed condition during machining. These factors cause multiple deformation of the cutting tool [2]. The friction resistance over the