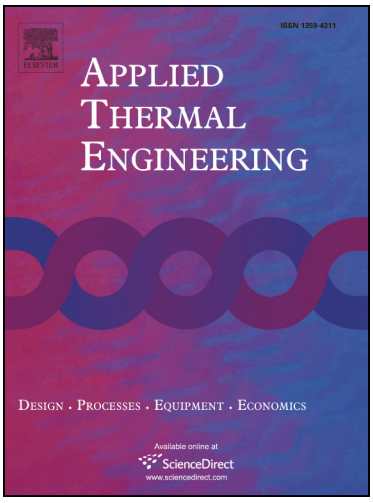

New Calibration method to measure Rake Face Temperature of the tool during Dry Orthogonal Cutting using Thermography

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New Calibration method to measure Rake Face Temperature of the tool during Dry Orthogonal Cutting using Thermography

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Abstract

A new method for measuring temperature in the rake face of a tool during dry orthogonal cutting using thermography is presented. In addition, a new technique is also used to calibrate the infrared camera. Using this technique, real temperature values from camera response are directly obtained without the need for emissivity correction. Emissivity is thus not an uncertainty source. These techniques were applied to machining AISI 4140. Rake face temperatures are reported and correlation with cutting forces outlined. The set-up effectively showed temperature distribution on the rake face.

Keywords: Temperature Measurement, Infrared Thermography, Metal Cutting, Orthogonal Cutting

1. Introduction

Heat generation occurring during metal cutting is an important factor which affects not only the properties of machined material but also tool life [1]. The temperature reached in the tool is an indirect measurement of heat produced due to the high plastic deformation of the material, and tool-chip and tool-workpiece friction [2]. This temperature has been recognized to significantly influence tool performance [3]. It is also a key to understand tool wear and final workpiece quality [4, 5]. Moreover, recent works [6] have shown good correlation between tool temperature and tool life tests.

Experimentally measured tool temperature could also be used to validate previously developed numerical models [7].

Several experimental techniques to measure the cutting tool temperature can be found in the literature. One of the most extensively used is thermocouples [8, 9]. Although thermocouples are inexpensive, they have several disadvantages: they interfere with the heat flow, have a limited transient response, and are difficult to use in order to obtain temperature gradients. Other techniques reported are those that use thermosensitive paints [10], or metallurgical methods [11]. However, due to its advantages, in the present work an infrared method, i.e. , thermography is considered.

Infrared Radiation (IR) thermometers have received great attention in recent years as devices for temperature measurement in machining processes [12, 13, 14]. The principal advantages of

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