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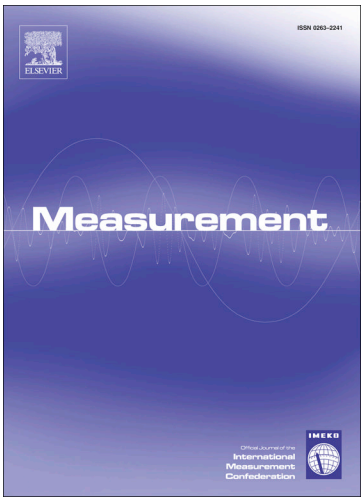

Experimental Investigations and Empirical Modeling for Optimization of Surface Roughness and Machining Time Parameters in Micro End Milling using Genetic Algorithm

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Abstract

Surface finish is a predominant requirement of a micro part inorder to perform satisfactory function. It is dependent on process variables such as cutting conditions, tool and work material properties, etc. In this work, an effort has been taken to propose realistic machining conditions for process improvement in micro end milling for C360 Copper alloy material. Solid Tungsten Carbide flat end mill cutter of size 700µm and 800µm are chosen as the tool material. Response surface methodology was incorporated for Design of experiments. First, experimental investigation was carried out to examine the effect of process condition include spindle speed and feed rate on Arithmetic Average Surface Roughness (R_a) and machining time values and also uncertainty in measured values. Analysis of variance was performed to establish the significant effect of cutting conditions on response values. Empirical model has been developed by experimental results using regression techniques in order to frame the fitness function. Parameters optimization for fine surface finish with minimum machining time has been carried out using Genetic Algorithm (GA). Confirmation experiments were carried out to validate the correctness of GA result and micro channels are fabricated successfully.

Keywords: Micro End Milling, Surface Finish, Machining Time, Genetic Algorithm, Optimization

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1. Introduction

Technology development forces the need for the introduction of variety of industrial products with miniaturization in size. Micromachining is one of the advanced technologies for the fabrication of micro and miniature parts with desired accuracy without sacrificing the functionality. Realization of micromachining technology requires development in the field of machine tool, process improvement and online measurement to attain the required accuracy and surface finish, Asad et al [1]. Micro milling has the capability to produce 2.5 and complex 3D micro parts in range of materials, especially engineering alloys. Working principle is similar to macro milling operation, ie., spindle rotates the micro end mill cutter to remove a material from

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