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Modelling and optimization of surface roughness during AISI P20 milling process using Taguchi method

Machaka, Ronald
Council for Scientific and Industrial Research
Pretoria, 0001, South Africa
Email: RMachaka@csir.co.za

Abstract

Surface roughness Ra is a parameter normally used to indicate the level of surface irregularities during machining operations. This work aims to model the cutting process, correlate and optimise the critical process parameters using the Taguchi method during the milling operation of AISI P20 in order to reduce surface roughness. The Autodesk Fusion 360 (2.0.5357) was employed for modelling the stress, displacement and thermal behaviour of the cutting tool and work piece under different cutting conditions. The experimental plan was based on Taguchi's technique including L9 orthogonal array with three factors and three levels for each variable and studying the contribution of each factor on surface roughness. The Taguchi method was used to study the effect of process parameters and establish correlation among the cutting speed, feed and depth of cut with respect to the major machinability factor, surface finish. The machining parameters evaluated in this study are the depth of cut (d), spindle speed (N) and cutting feed (fm) while the response factor measured is surface roughness. The physical experiments were conducted on M200 TS material on a DMC 635 V DMG ECOLINE, Deckel Maho Germany, Siemens 810D, 3-Axis, CNC vertical milling machine using carbide inserts and the surface roughness was measured using the Mitutoyo SJ–201, surface roughness Machine. The statistical analysis of both the numerical and physical experiments brought about the development of a mathematical model and optimum solutions for the evaluation of surface roughness during the milling process with high degree of correlation with experimental values thus validating the developed model.