Investigating the Possibility to Reduce the Residual Stress Level in 2.5D Cutting Using Titanium Coated Carbide Ball End Mill

N Masmiat, HS Chan, Ahmed AD Sarhan, MA Hassan, M Hamdi

Abstract:

End milling is a multipoint cutting process in which material is removed from a workpiece by a rotating tool. It is widely used in cutting 2.5D profiles such as point-to-point, contouring, and pocketing operations. 2.5D machining possesses the capability to translate in all 3 axes but can perform the cutting operation in only 2 of the 3 axes at a time. This study focuses on optimizing the cutting parameters, such as machined surface inclination angle, axial depth of cut, spindle speed, and feed rate for better surface integrity, namely, microhardness, residual stress, and microstructure in 2.5D cutting utilizing a titanium-coated carbide ball end mill. An optimization method known as Taguchi optimization, which includes planning, conducting, and analyzing results of matrix experiments, was used in order to achieve the best cutting parameter level. Data analysis was conducted using signal-to-noise () and target performance measurement (TPM) response analysis and analysis of variance (Pareto ANOVA). The optimum condition results obtained through analysis show improvements in microhardness of about 0.7%, residual stress in the feed direction of about 18.6%, and residual stress in the cutting direction of about 15.4%.

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