Effect of Machining Process Parameters on Acceleration Signal in Determining Surface Quality of Milling Process at Ductile Iron

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Abstract. The present work studies the effect of machining parameters for determining surface quality during milling process of ductile iron under different lubrication conditions. It was conducted by adopting direct and indirect measurement using two accelerometers with coated and uncoated tool. The experiment data was collected by inputs of spindle speed, feed rate, axial-radial depth of cut, and MQL flow rate. The response in term of vibration signal was measured and extracted from time series data into kurtosis and skewness analyses. For direct measurement, surface qualities from experimental configuration of workpiece were measured using roughness tester for verification and comparison. Alternatively, the result verified the different effect of machining process parameters contributes to different surface quality based on kurtosis and skewness analyses for the indirect measurement.

Keywords: Machining Parameter Selection, Vibration Signal, Coated Tool, Uncoated Tool, Kurtosis, Regression, Minimal Quantity Lubrication (MQL), Surface Roughness

1 Introduction

Milling is one of common and efficient cutting process and the application has contributed into various engineering and manufacturing industries. The efficiency of milling is highly dependent on quality performance like surface finish, tool life and wear, cutting force, temperature and coolant consumption [1]. The influential factors like spindle speed, feed rate, axial-radial depth of cut, and materials used are considered as parameter input [2]. This is to reduce the complication that leads to the milling tool-workpiece failure [3] and increase the processing cost [4] subsequently. In the recent decades, industries have been moving towards sustainable production besides environmentally friendly and therefore MQL was adapted as potential substitute for traditional cutting coolant. Khan and Dhar outlined advantages using vegetable-based oil besides of biodegradability, high lubrication and stability [5]. Boswell reviewed that over the years, MQL are significantly comparable to traditional flood coolant [6]. For instance, the range of cutting fluid consumption is between 50 ml/h to 2000 ml/h [7] whereas other

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