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Optimization of Machining Parameters for Surface Roughness During 2.5D Milling

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Abstract: Optimization of machining parameters has been of paramount importance for high quality and efficient milling operations. Surface roughness, in addition to the part geometry, is also one of the important aspects for the quality of most of the manufactured parts. The low surface roughness might be attained at the expense of low material removal rate. As the cost of production mainly depends upon the material removal rate and tool life, hence lowering the metal removal rate leads to higher production cost. In this highly competitive environment the manufactures have to make a compromise between the quality of product and cost of production. So a strategy needs to be developed for minimization of surface roughness by selecting optimum combination of machine parameters with the constraints of material removal rate and tool life. In the present work, an attempt has been made to optimize machining parameters such as feed per tooth, speed and depth of cut (DoC) for minimizing the surface roughness during 2.5D milling. Response surface methodology has been applied for designing of the experiments, whereas, regression analysis has been applied to develop the mathematical model of surface roughness for independent process parameters. The mathematical model developed for surface roughness with the help of an experimental setup has been considered as the fitness function in the proposed GA. Optimal values of machining parameters have been calculated for a real life problem and compared with handbook recommendations. ANOVA has also been applied to find out the significance of the machining parameters with the surface roughness. Approximately 14% reduction in surface roughness has been observed over the handbook recommended combinations of machining parameters by choosing optimal combination under the defined constraints. Besides this, the feed per tooth and DoC have also been found significant with the surface roughness.

Keywords: Process Parameters, 2.5D Milling, Genetic Algorithm, Surface Roughness, RSM, Regression Analysis