Abstract

Extreme international economic competition has focused the attention of manufacturers on automation and flexible manufacturing as means of increasing the productivity and the quality of manufactured products. This trend toward automation has created a need in industry for a comprehensive approach to product quality. To realize successfully full automation in machining, approaches and devices to predict and monitor continuously and reliably the machining process are needed. These will allow quality assurance to be merged with manufacturing processes, with the goal of approaching zero defect production.

A large number of theoretical and experimental studies on surface roughness of machined products have been reported. These studies show that cutting conditions, tool wear, the material properties of tool and workpiece, as well as cutting parameters (cutting speed, depth of cut, feed rate, and tool geometry) significantly influence the surface finish of machined parts. Machining with CNC requires that an operator select the process parameters such as feed rate and spindle speed, thus the process still depends on knowledge and experience. To prevent an unsatisfactory surface finish the most common strategy involves the selection of conservative process parameters, which neither guarantees the achievement of desired surface finish nor attains high metal removal rate. To overcome these problems, the researchers propose models that try to simulate the conditions during machining of different materials and establish the relationship between various factors and desired product characteristics. Hence a proper estimation of surface roughness is a major part of this work. And to examine the behaviour of FEA and optimization of major structural part is a minor work related to thesis.

Design of experiments has been used to study the effect of the main turning parameters such as feed rate, tool nose radius, cutting speed and depth of cut on the surface roughness of AISI 1040 steel, AISI 410 steel, Mild steel and Aluminium. To establish the prediction model, regression analysis is conducted with 2^{5-1} fractional design is used for different set of materials. Also a mathematical prediction model of the surface roughness has been developed in terms of above parameters. The effect of these parameters on the surface roughness has been investigated by using Response

Surface Methodology (RSM). Response surface contours were constructed for determining the optimum conditions for a required surface roughness. The developed prediction equation shows that the feed rate is the main factor followed by tool nose radius and cutting speed influences the surface roughness. The surface roughness was found to increase with the increase in the feed and it decreased with increase in the tool nose radius and cutting speed. Depths of cut have no significant effect on the surface roughness. By using response surface methodology and (3^4) full factorial design of experiment, quadratic model has been developed with 95% confidence level.