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Parametric Optimization of High Speed CNC Turning Operation for Improving the Surface Quality of (AA6063-T6) Aluminium Alloy Components

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Abstract : This paper elucidates the effect of high speed CNC turning parameters cutting speed, feed rate and depth of cut on the surface quality of AA6063-T6 aluminium alloy. The experiments are conducted based on the three level full factorial design (3^3) and surface finish was tested on the finished components machined by high speed CNC turning centre. A mathematical expression representing surface roughness was developed using non-linear regression analysis. The optimization techniques namely Taguchi method and genetic algorithm have been used to optimize the turning parameters for obtaining best surface roughness of the components. The optimum parametric conditions of turning operation have been tested with the confirmation experiments. It has been well-known from the results that the optimum condition obtained by genetic algorithm outperformed the results obtained from experimental design and Taguchi method.

Keywords : AA6063-T6 aluminium alloy, High speed CNC turning operation, Surface roughness, Taguchi method, Genetic algorithm.

1. Introduction

Aluminium alloys are extensively used in numerous sectors such as aerospace, marine, automotive, defense, etc., due to their enviable properties like more strength, less weight, high wear resistance, high thermal conductivity and low thermal expansion [1-3].

According to economical and dynamic market situation, the production industries are forcefully allocated to cost-effective machining under difficult machining conditions for the parametric optimization of production processes [4-6]. Developing high quality product with low manufacturing cost is the key purpose of all metal processing productions. The high speed machining and recent machining technologies are extensively used to turn the components that require high degree of surface quality [7-9]. The surface texture is one of the major necessities for machined parts because it is used to evaluate the degree of surface quality of the parts. In order to acquire improved surface finish, the appropriate fixing of cutting parameters is greatest important earlier to machining. [10-12].

The turning is one of the furthestmost machining process in which a single point cutting tool eliminates undesirable material from a revolving cylinder-shaped work piece. The increasing importance of high speed turning operation gains new dimensions in the present industrial age [13-15]. The high speed CNC turning