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# Optimization of Machining Parameters in Face Milling

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**ABSTRACT:** Every manufacturing industry wants to reduce the manufacturing cost and increase the quality of a product. The aim of this project work is to optimize the selected control factors in order to reduce surface roughness in dry end milling operation. In this project Taguchi method is used to determine the optimum machining parameters more efficiently. The cutting parameters are spindle speed, feed rate and depth of cut. These parameters are investigated at three different levels. On the basis of L9 orthogonal array of Taguchi method L9 experiments were performed. The machining operation performed on vertical machining centre without using coolant. The surface roughness was measured by the device Surface Roughness Tester. These experimental data were analyzed using Minitab software to identify the most significant factor. The material used in this project is Al6082 Aluminium alloy.

**KEYWORDS:** Surface Roughness, Taguchi, ANOVA, Minitab, End mill.

## I. INTRODUCTION

CNC Machines - An Overview It has long been recognized that conditions during cutting, such as feed rate, cutting speed and depth of cut, should be selected to optimize the economics of machining operations, as assessed by productivity, total manufacturing cost per component or some other suitable criterion. Since long researchers showed that an optimum or economic cutting speed exists, this could maximize material removal rate. Manufacturing industries have long depended on the skill and experience of shop-floor machine-tool operators for optimal selection of cutting conditions and cutting tools. Considerable efforts are still in progress on the use of handbook based conservative cutting conditions and cutting tool selection at the process planning level. The most adverse effect of such a not-very scientific practice is decreased productivity due to sub-optimal use of machining capability. The need for selecting and implementing optimal machining conditions and the most suitable cutting tool has been felt over the last few decades.

Despite early works on establishing optimum cutting speeds in CNC machining, progress has been slow since all the process parameters need to be optimized. Furthermore, for realistic solutions, the many constraints met in practice, such as low machine tool power, torque, force limits and component surface roughness must be overcome. The non-availability of the required technological performance equation represents a major obstacle to implementation of optimized cutting conditions in practice. This follows since extensive testing is required to establish empirical performance equations for each tool coating work material combination for a given machining operation, which can be quite expensive when a wide spectrum of machining operations is considered. The F8 large, vertical machining centre is designed to provide the power, speed, precision and versatility to attack both large production part applications as well as big die and mold components. The F8 is designed to provide stiffness and rigidity for chatter-free, heavy cutting, roughing and finishing on the same machine, agility for high-speed / hard-milling and accuracies for tight-tolerance blends and matches typical of complex, 3-D contoured geometry associated with die/mold and medical production. The unique machine design provides unparalleled access to ease setup and changeover reducing WIP and overall lead time.



## II. RELATED WORK

The many researchers have research on material Al6082, but very few researchers has research work on End milling operation on Al6082. In this present work we are selected the material Al6082. The objective of present work is to optimize the cutting parameter of Al6082 in dry end milling operation.

Shetty et al. (2008) were conducted an experiment and used Taguchi and Response Surface Methodologies for minimizing the surface roughness in turning of discontinuously reinforced aluminium composites (DRACs) having aluminium alloy 6061 as the matrix and containing 15 vol.% of silicon carbide particles of mean diameter 25  $\mu$ m under pressured steam jet approach. They found the optimum condition for minimum surface roughness [1].

Muammer Nalbant et al. (2009) were conducted an experiment and seen the effects of machining on AISI 1030 steel uncoated, PVD- and CVD-coated cemented carbide insert variation in feed rates, cutting speeds while keeping depth of cuts constant. This process was done without using cooling liquids. The result shows that a negative relationship between the average surface roughness and cutting speed for this tool. The surface roughness was decreased by increasing cutting speed.[2]

Yallese et al. (2010) were conducted the experiment for cutting forces in dry turning operation of AISI 52100 hot work-piece steel (50 HRC). They performed 27 experiments and specified effects of parameters like cutting speed, feed rate and depth of cut. They found that the most important factor affecting the components of the cutting forces was depth of cut.[3]

Sahoo (2011) was conducted an experimental study to investigate the effects of cutting speed, feed rate and depth of cut for minimum surface roughness for AISI 1040 steel when the material were machined on a CNC turning machine (lathe). ANOVA software was use to analysed the result for purpose of optimising the parameter. [4]

Kamal Hassan et al. (2012) were conducted an experiment and seen the effects of process parameters on Material Removal Rate (MRR) in turning operation of material C34000. The Cutting speed, feed rate and depth of cut were taken cutting parameters in this experiment and result were analysed ANOVA in MINITAB 16 @ software. The cutting speed and feed rate were most dominated factor for MRR. The conclusion shows that the MRR rate was increased by increasing the cutting speed and feed rate. [5]

## III. METHODOLOGY

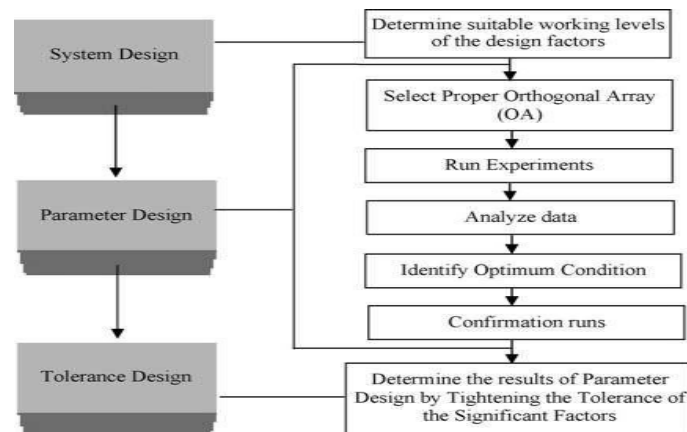
Optimization of process parameters is the key step in the Taguchi method in achieving high quality without increasing the cost. This is because optimization of process parameters can improve performance characteristics and the optimal process parameters obtained from the Taguchi method are insensitive to the variation of environmental conditions and other noise factors. Basically, classical process parameter design is complex and not easy to use. Especially, a large number of experiments have to be carried out when the number of the process parameters increases.

Experimental results

The Taguchi method uses S/N ratio instead of the average value to infer the trial results data into a value for the evaluation characteristics in the optimum setting analysis. This is because S/N ratio can reflect both average and variation of the quality characteristics. In the present work, the optimization of CNC MACHINING process parameters using Taguchi's robust design methodology with multiple characteristics is proposed. In order to optimize the multi performance characteristics, namely Cycle Time and Surface roughness ( $R_a$ ) while machining in CNC of Stainless Steel310material. Here performances namely  $R_a$  and cycle time are to be minimized.

Most of the investigations presented in section2 employed Taguchi techniques, such as orthogonal arrays and S/N ratio analysis to optimize values of cutting parameters that minimize the response variable. Taguchi methodology allows obtaining results using fewer experimental runs than other techniques. One method presented in this study is an experimental design process called the Taguchi design method. Taguchi design, developed by Dr. Genichi Taguchi, is a set of methodologies by which the inherent variability of materials and manufacturing processes has been taken into account at the design stage. The application of this technique had become widespread in many US and European industries after the 1980s.

The beauty of Taguchi design is that multiple factors can be considered at once. Moreover, it seeks nominal design points that are insensitive to variations in production and user environments to improve the yield in manufacturing and the reliability in performance of a product. Therefore, not only can controlled factors be considered, but also noise factors. Although similar to design of experiment (DOE), the Taguchi design only conducts the balanced (orthogonal) experimental combinations, which makes the Taguchi design even more effective than a fractional factorial design. By using the Taguchi techniques, industries are able to greatly reduce product development cycle time for both design and production, therefore reducing costs and increasing profit. Moreover, Taguchi design allows looking into the variability caused by noise factors, which are usually ignored in the traditional DOE approach.



**Figure1 Taguchi Design Procedure.**

#### IV. CONCLUSION

In this project an attempt to utilize Taguchi optimization approach to optimize machining parameters during face milling of aluminum alloy using milling insert tool. The parameters are cutting speed, feed rate and depth of cut. Milling experiments were performed to enhance the surface finish of aluminum alloy 6082 through the usage of insert cutter 20 mm diameters the aid of the usage of Taguchi's method which include L9 orthogonal array.

By observing the experimental effects via Taguchi, the following conclusions may be made: After completing the experiment it can be observed that optimal value of surface finish is obtained at third level of Spindle Speed and it was 1200rpm, second level of Feed Rate and it was 200mm/min and second level of Depth of Cut and it was 1.0mm. After completing the project it can be observed that the optimal value of material removal rate is obtained at second level of cutting Speed and it was 1000rpm, second level of Feed Rate and it was 200mm/min and third level of Depth of Cut and it was 1.5mm.

The most influencing factor of surface finish is feed rate followed by cutting speed and the depth of cut is the least factor. The most influencing factor of metal removal rate is depth of cut followed by feed rate and the cutting speed is the least factor.

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