ABSTRACT:
In machining operations, achieving desired surface quality features of the machined product, is really a challenging job on cnc machine. Because, these quality features are highly correlated and are expected to be influenced directly or indirectly by the direct effect of process parameters. However, the extents of significant influence of the process parameters like speed, feed, and depth of cut are different for different responses. Therefore, optimization of surface roughness and mrr is a multi-factor, multi-objective optimization problem. Therefore, to solve such a multi-objective optimization problem, it is felt necessary to identify the optimal parametric combination, following which all objectives could be optimized simultaneously. In this context, it is essential to convert all the objective functions into an equivalent single objective function or overall representative function to meet desired multi-quality features of the machined surface. The required multi-quality features may or may not be conflicting in nature. The representative single objective function, thus calculated, would be optimized finally. In the present work, Design of Experiment (DOE) with full factorial design has been explored to produce 27 combinations of turning parameters like cutting speed, feed, and depth of cut to achieve optimal values to explain the effect of process parameter on mrr and surface roughness. A typical CNC system consists of the following six elements
- Part program
- Program input device
- Machine control unit
- Drive system
- Machine tool
- Feedback system
Figure 1. Major components of a numerical control machine tool

2. LITERATURE SURVEY
Many investigators have suggested various methods to explain the effect of process parameter on mrr and surface roughness.
Mr. Ballal Yuvaraj P, et al. [1] were carried out “Application of taguchi method for design of experiments in turning gray cast iron”. They describe use and steps of Taguchi design of experiments and orthogonal array to find a specific range and combinations of turning parameters like cutting speed, feed rate and depth of cut to achieve optimal values of response variables like surface finish, tool wear,
material removal rate in turning of Brake drum of FG 260 gray cast iron Material. Three parameters namely feed rate, spindle speed and depth of cut are varied to study their effect on surface finish, tool wear and mrr. They carried out experiments on turn 5075 CNC lathe with CNMA 120408 as a tool material. They carried out experiments with Minitab and ANOVA software for effect analysis. They selected L27 orthogonal array for the Taguchi design. Taguchi parameter design offers a simple, systematic approach and can reduce number of experiment to optimize design for performance, quality and manufacturing cost. It is a scientifically disciplined mechanism for evaluating and implementing improvements in products, processes, materials, equipments and facilitie.

Kamaraj Chandrasekar, et al, [2] were carried out “Computer Numerical Control Turning on AISI410 with Single and Nano Multilayered Coated Carbide Tools under Dry Conditions”. They carried out experiments with carbide tools coated with multilayered TiCN+Al2O3, multilayered Ti (C, N, B), single layered (Ti, Al) N, and Nano multilayered B-Tic are used for the turning study on AISI410, under dry conditions on CNC. Different cutting parameters, namely, cutting speed, feed rate, and depth of the cut are used for the optimal setting of the parameters on turning AISI410. Experiments were carried out using the Taguchi’s L27 orthogonal array. The effect of cutting parameters on surface roughness (SR) was evaluated and optimal setting conditions were determined for minimization of SR. Analysis of variance (ANOVA) was used for identifying the significant parameters affecting the response. They concluded from the results of ANOVA, the feed rate and cutting speed are the significant cutting parameters affecting the SR with Ti (C, N, B), (Ti, Al) N, and B-Tic, the feed rate and depth of cut are the significant cutting parameters affecting the SR with TiCN+Al2O3, a minimum SR value was obtained using multilayered B-Tic carbide tools rather than TiCN+Al2O3, (C,N,B) and (Ti,Al)N.

M.Janardhan, et al,[3] were carried out “Determination and Optimization of cylindrical Grinding process parameters Using taguchi method and Regression analysis”. A set of experiments were conducted on cylindrical grinding machine on EN8 material. The Experiments were conducted on CNC cylindrical grinding machine with L9 Orthogonal array with input machining variables as work speed, feed rate and depth of cut. Empirical models are developed using design of experiments and response surface methodology. The adequacy of the developed model is tested with ANNOVA. MINITAB15 software is used is for analysis of response graphs of average values and S/N ratios. From the Pareto analysis it is evident that the feed rate played vital role on output responses surface roughness and metal removal rate (MRR) than other process parameters. The developed model can be used by the different manufacturing firms to select right combination of machining parameters to achieve an optimal metal removal rate (MRR) and surface roughness (Ra). The results reveals that feed rate, depth of cut are influential factors in the output responses metal removal rate (MRR) and surface roughness (Ra). The predicted optimal values for MRR, Ra for Cylindrical grinding process are 62.05 gm/min and 0.816 µm respectively. The results are further confirmed by conducting confirmation experiments. Kamal Hassan, et al, [4] were carried out “Experimental investigation of Material removal rate in CNC turning using Taguchi method”. This study investigates the effects of process Parameters on Material Removal Rate (MRR) in turning of C34000. Medium brass alloy (C34000) of Ø: 19 mm, length: 280 mm were used for the turning experiments in the present study. The turning tests were carried out to determine the material removal rate under various turning parameters. GC1035 coated carbide tool were used for experimental investigations. The single response optimization problems i.e. optimization of MRR is solved by using Taguchi method. The optimization of MRR is done using twenty seven experimental runs based on L’27 orthogonal array of the Taguchi method are performed to derive objective functions to be optimized within the experimental domain. When the MRR is optimized alone the MRR comes out to be 8.91. The optimum levels of process parameters for simultaneous optimization of MRR have been identified. Optimal results were verified through confirmation experiments. The Material removal rate is mainly affected by cutting speed and feed rate. With the increase in cutting speed the material removal rate is increases & as the feed rate increases the material removal rate is increases. From ANOVA analysis, parameters making significant effect on material removal rate feed rate, and interaction between feed rate & cutting speed were found to be significant to Material removal rate for reducing the variation. The parameters considered in the experiments are optimized to attain maximum material removal rate. The best setting of input process parameters for defect free turning (maximum material removal rate) within the selected range is as: i) Cutting speed i.e. 55m/min. ii) Feed rate i.e. 0.35mm/rev. iii) Depth of cut should be 0.2mm. Ishan B Shah, et al, [5] were carried out “Optimization of Cutting Tool Life on CNC Milling Machine through Design of Experiments-A Suitable Approach – An overview”. This paper discuss of the literature review of Optimization of tool life in milling using Design of experiment implemented to model the end milling process that are using solid carbide flat end mill as the cutting tool and stainless steels s.s-304 as material due to predict the resulting of Tool life. Data is collected from CNC milling machines were run by 8 samples of experiments using DOE approach that generate table design in MINITAB packages. The inputs of the model consist of feed, cutting speed and depth of cut while the output from the model is Tool life calculated by Taylor’s life equation. The model is validated through a comparison of the experimental values with their predicted counterparts. The optimization of the tool life is studied to compare the relationship of the parameters involve. Experimental results show that in milling operations, Use of Low depth of cut, Low cutting speed and high feed rate are recommended to obtain better Tool life for the specific Range. The following additional experimental results also being achieved through the experiment and they are: Improvement in tool life = 28%. Increment in
The study aimed at evaluating the best process environment which could simultaneously satisfy requirements of both quality and as well as productivity. The predicted optimal setting ensured minimization of surface roughness and maximization of MRR (Material Removal Rate). Optimal result was verified through confirmatory test.

H. Yanda, et al. [6] were carried out “Optimization of material removal rate, surface roughness and tool life on conventional dry turning of fcd700”. They investigate the effect of the cutting speed, feed rate and depth of cut on material removal rate (MRR), surface roughness, and tool life in conventional turning of ductile cast iron FCD700 grade using TiN coated cutting tool in dry condition. The machining condition parameters were the cutting speed of 220, 300 and 360 m/min, feed rate of 0.2, 0.3 and 0.5 mm/rev, while the depth of cut (DOC) was kept constant at 2 mm. The effect of cutting condition (cutting speed and feed rate) on MRR, surface roughness, and tool life were studied and analyzed. Experiments were conducted based on the Taguchi design of experiments (DOE) with orthogonal L9 array, and then followed by optimization of the results using Analysis of Variance (ANOVA) to find the maximum MRR, minimum surface roughness, and maximum tool life. The optimum MRR was obtained when setting the cutting speed and feed rate at high values, but the optimum tool life was reached when the cutting speed and feed rate were set as low as possible. Low surface finish was obtained at high cutting speed and low feed rate. Therefore time and cost saving are significant especially is real industry application, and yet reliable prediction is obtained by conducting machining simulation using FEM software Deform 3D. The results obtained for MRR using the proposed simulation model were in a good agreement with the experiments.

Figure 2 Main effects of cutting speed and feed rate parameters in the S/N ratio for MRR

M. Naga Phani Sastry, et al, [7] were carried out “Optimization of Performance Measures in CNC Turning using Design of Experiments(RSM)”. The investigated the effect of turning process parameters (cutting speed, feed rate, and depth of cut) on the metal removal rate and surface roughness as responses or output parameters. Response surface methodology (R.S.M), which is a part of DOE, is used to determine and present the cause and effect of the relationship between true mean response and input control variables influencing the response as a two or three dimensional surface. R.S.M has been used for designing a three factor with three level central composite factors design in order to construct statistical models capable of accurate prediction of responses. The results obtained showed that the application of R.S.M can predict the effect of machining parameters on MRR and surface roughness. A case study in straight CNC turning of aluminum bar using HSS tool is being considered. IJAERS/Vol. II/ Issue I/Oct.-Dec.,2012/100-103

J.S.Senthilkumaar, et al. [8] were carried out “Selection of machining parameters based on the Analysis of surface roughness and flank wear in finish Turning and facing of inconel 718 using taguchi Technique”. Single pass finish turning and facing operations were conducted in dry cutting condition in order to investigate the performance and study the wear mechanism of uncoated carbide tools on Inconel 718 in the form of cylindrical bar stock of diameter 38 mm. The experiments were conducted on the L16 ADVancer CNC lathe with constant speed capability. Uncoated carbide inserts as per ISO specification SNMG 120408-QM H13A were clamped onto a tool holder with a designation of DSKNL 2020K 12 IMP for facing operation and DBSNR 2020K 12 for turning operation. Cutting experiments were conducted as per the full factorial design under dry cutting conditions. The effects of the machining parameters on the performance measures surface roughness and flank wear were investigated. The relationship between the machining parameters and the performance measures were established using the non-linear regression analysis. Taguchi’s optimization analysis indicates that the factors level, its significance to influence the surface roughness and flank wear for the turning and facing processes. Confirmation tests were conducted at an optimal condition to make a comparison between the experimental results foreseen from the mentioned correlations. Based on Taguchi design of experiments and analysis, the cutting speed is the main factor that has the highest influence on surface roughness as well as flank wear of turning and facing processes. Optimal machining parameters for minimum surface roughness were determined. The percentage error between experimental and predicted result is 8.69% and 8.49% in turning and facing process respectively. Optimal machining parameters for minimum flank wear, the percentage error between experimental and predicted result is 4.67% for turning process and 2.63% for facing process. Based on the Taguchi’s optimization analysis for the turning process the cutting speed and depth of cut are the dominant factors whereas in facing process cutting speed and feed are dominant factors which affecting the performance measures.

3. CONCLUSION

From the above literature survey we find that there are many research done on optimization techniques for process parameter for surface roughness and material removal rate. But I found that there are very few research done on SS316 stainless steel so we want to do research on this material. We like to use gray relational analysis for optimization.

4. REFERENCES:


