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MULTIOBJECTIVE OPTIMIZATION OF TURNING OPERATIONS BASED ON THE RESPONSE SURFACE METHODOLOGY: A REVIEW

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Abstract

In the current global competitive environment, there is a need for the selection of the machining parameters is the most important task to the process planner to achieved the low cost as well as desired quality of machined components. This work is study about to finding new approach to the optimized the cutting parameters for optimum outputs. The various method is used to optimized the process parameters for optimum solution like; Response Surface Method, Taguchi Method, Genetic Algorithm Method etc. In present, the optimization is the main objective of the manufacturing process. In metal cutting operations require parameters that can withstand the extreme conditions produced during machining.

Keywords: *Optimization, Turning Process, Machining Parameters, RSM.*

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1. Introduction

Machining costs more than 20% of the value of products manufactured in industrialized countries. Therefore, it is mandatory to investigate the machinability behavior of different materials by changing the machining parameters to obtain optimal results. The machinability of a material provides an indication of its adaptability for fabrication by a machining process. Good machinability is defined as an optimal combination of factors such as low cutting force, good surface finish, low tool tip temperature, and low power consumption. Modeling and process optimization are two important issues in product manufacturing. Selecting the optimal cutting parameters, such as depth of cutting, feed and speed, is a very important issue for each machining process. In shop practice, the cutting parameters are chosen from specialized manuals or machining databases, but the limits given in these sources are actually initial values and not optimal values. Optimization of machining parameters not only increases usability for machining economics, but also increases product quality to a great extent. In today's manufacturing environment, many industries have tried to introduce Flexible Manufacturing Systems (FMS) as a strategy suited to the ever-changing competitive market requirements. To ensure the quality of mechanized products to reduce machining costs and increase machining efficiency, it is very important to select the appropriate machining parameters when selecting machine tools for machining.

Turning is a very efficient machining method to remove excess material from the base metal with the help of a single cutting tool through a rotating cylindrical workpiece. The cutting tool has a direction of travel similar to the axis of rotation of the work. The turning operation is performed on a lathe machine that provides the necessary power to rotate the work at the desired rotational speed with respect to the depth of the cut and depth. Therefore, the three cutting elements are the depth of cut, feed rate, and cutting speed to optimize in a turning process. Turning operation is a major operation used for manufacturing machine elements in manufacturing industries, i.e., shipping, automotive and aerospace.

2. Literature Review

Perumal et al. [1] performed experiments on two materials AISI 304 & AISI 306 Stainless Steel by using Titanium Carbonitride coated tool during CNC Turning and determined the optimum cutting parameters viz cutting speed, feed rate and depth of cut to obtain better Surface Finish by using Taguchi Method & S/N ratio was calculated. It was found that for both types of materials the optimum cutting speed was 1200 RPM, feed rate of 0.1 mm/rev and 0.4 mm depth of cut.

Kuppusamy and Ramalingam [2] studied the optimization of process parameters in CNC turning of Titanium alloy TI-16Al-7Nb with carbide coated tool inserts by using Taguchi analysis. The influence of individual turning parameters was carried by ANOVA. Finally, the desirability function approach is used in the optimisation of multi response surface through RSM.

Basmaci [18] has worked on optimisation of process parameters like feed rate, depth of cut and cooling system in turning of AISI 316L stainless steel using Taguchi method. The Taguchi's L9 orthogonal array is used to formulate the experiment layout. Cutting forces and surface roughness were measured by using Carbide tool material. With the help of Pareto's chart, it was determined that depth of cut and feed rate affect the cutting force is most.

Chandrasheker et al. [4] investigated the effect of four control factors viz cutting speed, feed rate, depth of cut and three cutting fluids (Sherol B, Sherol ENF, Straight Cutting Fluid) for optimising surface roughness produced during turning operation of AISI 316 stainless steel based on Taguchi methodology by using orthogonal array with three levels of control factors.

Alagarsamy et al. [5] studied optimisation of machining parameters like speed, feed and depth of cut for turning of aluminium alloy 7075 using Taguchi method by using tungsten coated carbide tool for material removal rate

(MRR) and machining time. The ANOVA (Analysis of Variance) and Signal to noise ratio (S/N) were employed to study the performance characteristics.

Asilturk et al. [6] this study involves modelling of experimental surface roughness of Co28Cr6Mo ASTM F 1537 medical alloy during CNC turning with input parameters as spindle speed, feed rate, depth of cut and tip radius by using Taguchi and RSM Designs. The optimised parameters were found to acquire minimum roughness with spindle speed 318 rpm, feed rate

Qureshi et al. [7] studied the optimisation of cutting parameters such as cutting speed, feed rate, depth of cut and nose radius for surface roughness in the turning of Steel with coated carbide inserts. The optimal combination were low feed rate and low depth of cut were beneficial for good surface finish.

Eldhose et al. [18] studied optimization of the cutting parameters of stainless-steel SS 304 for CNC turning operation by using Taguchi method. They have found that depth of cut is the most effecting factor on material removal rate, on surface roughness is steel and depth of cut, machining time and tool wear were mostly affected by feed and speed.

Sarikaya et al. [9] analysed the effects of the turning parameter viz cutting speed, feed rate, depth of cut cooling conditions on average surface roughness and average maximum height of the profile when turning AISI 1050 Steel by using Design of Experiments methodology. Tests are designed by Taguchi orthogonal array. The results were analysed by using ANOVA, 3D surface graphics and Signal to Noise ratio.

Makadia and Nanavati [10] studied the effect of main turning parameters like feed rate, nose radius, cutting speed and depth of cut on the surface roughness of AISI 410 Steel with ceramic inserts by using RSM. It was found that the feed rate is the main cutting parameter on the surface roughness followed by nose radius and cutting speed. Depth of cut have no significant effect on surface roughness.

Nayak et. al. [11], it has been concluded that multi objective optimization of the machining parameters was performed during dry turning of IASI 306 austenite stainless steel. Three characteristics of MRR, shear force and surface roughness were measured.

Beraneka and Kolarikb [12], concluded that the experiment was designed to optimize the bend parameters such as cutting speed, depth of cut and feed of duplex steel. Duplex steels are generally prone to mechanical reinforcement during machining the feed rate and cutting speed have a significant effect on the surface roughness parameter Ra, Ra where an increase in factors increases the surface roughness but then feeder 0.1 mm/rev was set, the lower the effect of speed.

Soltani and Shahali [13], investigated that an attempt has been made to model and optimize AISI D3 hardened steel for hard turns using reaction surface workup. The combined effects of four machining parameters were investigated, including cutting speed, feed rate, stiffness, and tool corner radius. The tool corner radius and feed rate are the largest effects on surface roughness, respectively. Between interactions, the effect of feed rate-corner radius, hardness-corner radius and shear speed-corner radius, respectively, were significant on surface roughness.

Thamizhmanii and Hasan [14], cutting inserts are used CBN inserts and cryogenically at −196 ° C. Cutting parameters are cutting speed with feed rate. Cryogenically treated CBN inserts have less wear on titanium than AISI 440 C steel. Flank wear on the titanium alloy was lower than the AISI 440 C.

Savadamuthu et al. [15], an optimal fuzzy control scheme designed by the Taguchi genetic method has been proposed to optimize the cutting parameters in turns. Orthogonal matrices, signal-to-noise ratios and analysis of variance are used to study the performance characteristics of AISI 1030 steel bar turning operations, using TIN coated tools. In this document an Adaptive Neuro-Fuzzy Invention System (ANFIS) is proposed to control a continuous cutting force bend process under different cutting conditions, consisting of two parts: the predictor and the fuzzy logic controller.

3. Conclusion

- To achieve this, it is necessary to carry out the analysis of knowledge to be constructed through an adequate statistical design. Statistical design of experiments refers to the method of design of experiments so that the appropriate knowledge is analysed to be successful in the specified conclusion.
- Design and method, such as factorial design, response surface methodology, and the Taguchi method, are widely used instead of the one-factor-as-a-time experimental approach, which is time-consuming and expensive.
- Find optimal parameters to give minimum surface roughness and analyse the effect of machining parameters on surface finish.

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