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Short Review Paper

Study of performance of milling machine for optimum surface Roughness

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Abstract

Milling process is used to remove material by a rotating cutter. This process of machining is used by the industries usually, and by cutting away the material which is unnecessary. Milling machine is used to produce a variety of character on a part. Central workshop of Bhilai Institute of Technology Durg which is the top most engineering collage of central India has two milling machines which are used to perform practical's of engineering students. The aim of this paper is to get optimum surface roughness, which identify the parameter of machine. Surface roughness is one of the most specific consumer requirements in a machining process. Surface roughness actually means fine irregularities of surface texture. Also surface roughness takes place due to the tool chip interface and feed marks in machining process. The quality of surface plays an important role in evaluating productivity of machine tool and machined parts. Several parameters of milling process are there like speed of cutting, feed, Cutting depth, rate of material removal also known as MRR and time taken by the machine etc. which play a critical role on surface roughness. These parameters are focussed on by many researchers and it is found that the process parameter cutting speed, depth of cut and feed are critical parameters which influence the surface roughness of work piece. So from optimization point of view, these three process parameter (feed, cutting depth and speed of cutting) should be selected. A suitable method of optimization is needed to find optimum value of parameters for cutting and minimizing roughness of surface. Taguchi method will be used to get optimum surface roughness. Taguchi's orthogonal array should be used to determine the parameter setting. Analysis of variance (ANOVA) will be used for result analysis. For carrying out process of machining, Mild steel will be used in water cooling condition in milling machines.

Keywords: Surface roughness, Milling, Optimization, Process Parameter, Taguchi method, ANOVA.

Introduction

Milling is a metal removal operation. In milling operation metal is removed by a rotating multipoint cutter which is fitted on the arbor of the milling machine. The varieties of features are formed by milling machine on a part by cutting away the unnecessary material. Milling machine is having certain main components, which are its column, saddle, its Base, table, knee, arbour, over-arm and spindle. In milling process, certain aspects plays a very important role such as work-piece, fixture, and cutter which are needed in milling machine. The work-piece is held in a fixture, attached to a table of milling machine. Three table movements are possible in a Milling machines i.e., crosswise, vertical, and longitudinal but rotational or swivel movement are also found with respect to the table in some cases. In improving Process of Milling, a very important role is played by the quality of surface. The fatigue strength, corrosion resistance, or creep life is improved by a good surface. Surface roughness affects a number of functional attributes of parts, such as, friction between two contacted parts, parts wearing, reflection of light transmission of heat, distributing ability and lubricant holding a, capacity of load bearing, coating or fatigue resisting etc. Therefore, the selected of processes should be proper during the operation and the desired finished surface is specified. For optimum surface roughness, Taguchi method can be used to optimize the process parameter.

Taguchi Method: To optimize parameters of a process and improve the components quality, that are manufactured Taguchi Method is used which is actually statistical approach. Taguchi and Konishi have developed the Taguchi method. Primarily To improving the manufactured goods (development of manufacturing process) quality, Taguchi method was developed. At a later stage its application of this method was expanded to various other engineering fields, like Biotechnology etc. Taguchi's efforts have been acknowledged by qualified statisticians especially in the development of designs for studying variation. Desired results are successfully achieved by careful selection of control factors and divide them into control and noise factors. Control factors must be selected in such a way that it eliminates the effect of noise factor. Proper control factors are recognised by Taguchi method and optimum results of the process are obtain by this method. To conduct a set of experiments orthogonal array (OA) are selected. To analyze the data and predict the quality of components produced, results of these experiments are used.

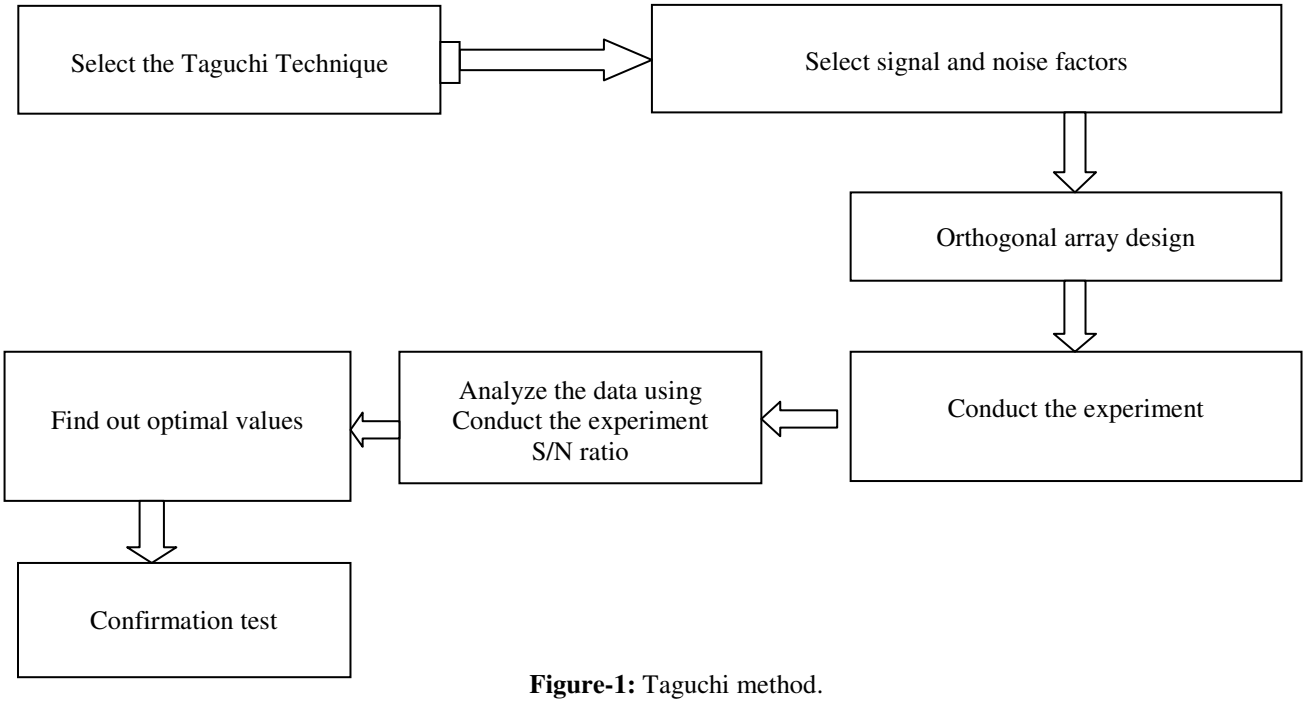

Figure-1: Taguchi method.

ANOVA: The evaluation of response magnitude in percentage (%) for each parameter of orthogonal array, analysis of variance (ANOVA) is used. It is used to quantify and identify the source of results of different trial from different trial runs (i.e. different cutting parameters). The ANOVA is basically a method in which the differences among the different groups are tested. Initially Prof. R.A. Fisher was the man who use this term and later it was developed by Prof. Snedecor and many others. The basic property of ANOVA is that the total sum of the squares (total variation) is equal to the sum of the SS (sum of the squares of the deviations) of all condition parameters and the error components.

Literature survey

Selvam et al.[1] have stated that the roughness of surface of mild steel is minimized by using generic algorithm and Taguchi technique. Carbide tools coated with Zinc are used in the experiment. The conduction of experiment was done on the CNC vertical machining centre of FANUC series. He stated that the cutting depth , number of pass, speed of spindle and rate of feed affect the roughness of surface in face milling operation. It is observed that the orthogonal array of Taguchies gives information of large amount even in experimentation of smaller amount. Through Taguchi technique, it is observed that all four parameters (number of pass, cutting depth, feed rate and speed of spindle) are predominantly contributing to response and all have been considered optimum machining parameter combination and fine tune with generic algorithm. Both techniques Results are compared and for optimum surface roughness, optimum machining parameter combination is suggested.

Verma Narendra Kumar et al.[2] investigated that the roughness of surface is affected mainly by rate of feed, depth of cut and speed of spindle. He observed that with the increase in rate of feed, the roughness of surface also increases and as the depth of cut increases the surface roughness increase first and then decreases as the speed of spindle increases due to which surface roughness decreases. It has been found that rate of feed is the most significant factor which affect the work piece surface roughness. In this experiment AISI 1045 work piece is machined.

He observed that from ANOVA analysis the surface roughness is significantly affected by cutting factor feed rate and depth of cut. He also found that from ANOVA analysis rate of feed and speed of spindle make significant effect on material removal rate.

Raj Ashok R et al[3] observed that the surface roughness of EN 8steel plates are affected by major parameters like speed of cutting, depth of cut and feed. He stated that statically significant factor is cutting speed, which influence the roughness of surface in milling process. For machining of EN8 steel the best machining process is milling process other than conventional machining process. In his experiments for machining of EN 8 steel side and face milling cutter ware used which gives good quality of finished surface which is required.

Sukumar et al.[4] investigated that surface finish of the work piece is mostly influenced by the process parameter cutting speed, feed and depth of cut. The ANN is able to predict the roughness value with reasonable accuracy. To identify the combination of optimum parameter and getting good finish of the surface ANN

and Taguchi S/N ratio analysis are useful. In this paper milling, on AL 6061 material, experiment is performed. The roughness of surface is measured and recorded for each experiment and results are analyzed by using Taguchi S/N ratio and optimal controllable parameter combinations are identified.

Maiyar Lohithaksha M et al.[5] investigated that in machining of Inconel 718 alloy in end milling the gray relational analysis is an effective optimization tool. It has been found that optimal cutting parameter for the machining process are speed of cutting, rate of feed, and depth of cut. For optimization of parameter, Taguchi method is used. Analysis of variance (ANOVA) shows that the velocity of cutting is the most important parameter of machining followed by rate of feed affecting the characteristics of multiple performances. It has been seen surface roughness is decreased when material removal rate (MRR) is increased at the same time.

Sumesh A S et al.[6] stated in his paper the drilling of cast iron has carried out with HSS twist drill and the input drilling parameters considered as spindle speed, feed rate, and drill diameter and response obtained is hole surface roughness. The drilling parameters like speed of spindle, feed rate, and diameter of drill are optimized with respect to multiple performances in order to accomplish or get good quality of holes in cast iron drilling. Optimizations of parameter were carried out using Taguchi method. By using L9 orthogonal array a numbers of experiments of drilling on the radial milling machine were conducted. To determine the most significant control factor affecting the roughness of surface, analysis of variance (ANOVA) was employed.

J.A. Ghani et al.[7] stated that in his paper Taguchi methodology is used for optimization. In the machining of hardened steel with AISI H13 and tin coated P10 carbide insert tool Taguchi method is used for optimization of cutting parameter. Cutting speed, feed rate and depth of cut are the milling parameter. To analyze the effect of milling parameter an orthogonal array, signal-to-noise (S/N) ratio of Taguchi method and analysis of variance are used. In the analysis of result he observed that high cutting speed, low feed rate and low depth of cut are the optimum combination for low resultant cutting force and good surface finish. The study shows that the Taguchi method is suitable to solve the stated problem with least number of trials as compared to a full factorial design.

Alagarsamy S.V. et al.[8] stated that Taguchi method is applied for obtaining optimum condition for optimizing material removal rate for turning of Aluminum alloy 7075 under dry cutting condition. Feed, speed of Cutting and depth of cut are the optimization parameter used.

It is observed that the speed of cutting is the most significant parameter influence the material removal rate (MRR) followed by rate of feed and depth of cut, the least significant factor. For analysis the result analysis of variance (ANOVA) is used.

Ribeiro Joao et al.[9] investigated that to optimize quality of surface in CNC end milling operation, Taguchi design application is implemented. This study includes process parameter like feed per tooth, speed of cutting, and radial depth of cut. AN orthogonal array L9 was used and to identify the significant factor influencing the surface roughness, ANOVA analysis was carried out for analyzing the result. Hardened machine block was machined in this experiment with tungsten carbide coated tools. Radial depth of cut is observed asthe most influent parameter.

Thakre Avinash A. et al.[10] stated in his paper that minimizing the surface roughness, parameters spindle speed, feed, depth of cut and coolant flow are considered. To perform the experiments on 1040 MS material CNC vertical milling machine with carbide inserts was used. He observed that coolant flow mainly controls the surface roughness. Also it can be noticed that the spindle speed and flow of coolant are the major factors which ensure better finish of surface. In this paper Taguchi method has been successfully applied in face milling operation for optimizing material removal rate and surface roughness. To study the significance of each machining parameter, Analysis of Mean and variance technique is employed on the surface roughness.

Conclusion

It is observed from the literature survey that six researchers have taken speed of cutting, depth of cut and feed for their study, two have taken speed of spindle, depth of cut and feed, one has taken number of pass, depth of cut, spindle speed and feed rate and one has taken spindle speed, depth of cut, feed rate, flow of coolant and diameter of drill tool. Hence, this literature highlights three main parameters like speed of cutting, feed rate and depth of cut. The further study will be based on these three selected parameters.

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