Experimental Investigation & Analysis of Machining Parameters of CNC End Milling Operation: An Overview

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Abstract:
Milling is the mainly common form of machining. It is a material removal process, which can produce a variety of features on a part by cutting away the unnecessary material. The optimization is performed within the practicable region defined by the important constraints. In order to optimize the cutting conditions, the experimental relationships between input and output variables should be time-honored in order to expedite the output. Optimization of these analytical models helps to select suitable input variables for achieving the best productivity performance. In this review paper the study is enclosed concerning the optimization of dissimilar input parameters and results are analyzed, Particle swarm optimization (PSO) method is used for resulting the best possible set of values of input variables for most material removal rate.

Keywords: End Milling, Particle swarm optimization, Process parameter optimization

I. INTRODUCTION

Milling is the mainly common sort of machining, a material removing procedure, which can produce a collection of feature on a part by cutting away the unnecessary material. Rising productivity is one of uncertainties in the overall competitions so each group attempt to find new approaches for decreasing expenditure and growing quality of the manufacture. Automated manufacturing systems are broadly engaged in machining along with computer numerical control (CNC). Materials are machined in computerized numerical control to get superior surface finish, dimensional accuracy and geometrical shape. In machining significant quantity of material is removed from raw material in the form of chips to get the preferred profile. End milling process is one of the most fundamental and commonly encountered material removal operations in manufacturing industries counting the automobile and aerospace sector where quality is the key factor on the production of slots, dies. The quality of the surface plays a very important role in the performance of milling as a excellent quality milled surface drastically improves fatigue strength, corrosion resistance and creep life. Surface roughness also affects numerous functional attributes of parts such as wearing, heat transmission, ability of holding lubricant, coating. Thus the desired surface finish is frequently specified and suitable processes are selected to reach the required quality.

New research in the material science has been heading towards the development of new light weight engineering materials processing high specific strength and stiffness at high temperatures and good creep, fatigue and wear resistance. That is because advanced automotive and aerospace technology requires these materials to get better performance. End milling process is known as material removal process. This process and its machine tools are able of producing complex shapes with the help of multi tooth cutting tools. In the end milling process, a multi tooth cutter rotates along with different axes with reference to the workpiece. Milling is the process of cutting away material by feeding a workpiece past a rotating multiple tooth cutter. The cutting stroke of the many teeth in the region of the milling cutter delivers a fast method of machining.

There are generally two methods of milling, Climb and Conventional. Climb milling, is sometimes known as down milling, where the direction of the cutter rotation is the same as the feed direction. This method is possibly the most common option on the shop floor and will normally produce a good surface finish. Conventional milling is also sometimes referred to as up milling where the direction of the cutter opposes the feed direction. The machined surface may be smooth, angular, or curved. The surface may also be milled to
American Engineer presented statistics as he surface is linear in all three dimensions. The simplest and most efficient of swarms. PSO applies the concept of social interaction to problem solving. It activity for the PSO-Finding around in the search space looking for the best solution. Each particle is treated as a point in a N-dimensional space which adjusts its “flying” according to its own flying experience as well as the flying experience of other particles. Particle Swarm Optimization (PSO) incorporates swarming behaviors observed in flocks of birds, schools of fish, or swarms of bees, and even human social behavior, from which the idea is emerged. PSO is a population-based optimization tool, which could be implemented and applied easily to solve various function optimization problems, or the problems that can be transformed to function optimization. While searching for food, the birds are either scattered or go together before they locate the place where they can find the food. While the birds are searching for food from one place to another, there is always a bird that can smell the food very well, that is, the bird is perceptible of the place where the food can be found, having the better food resource information. Because they are transmitting the information, especially the good information at any time while searching the food from one place to another, conducted by the good information, the birds will eventually flock to the place where food can be found.

II. LITERATURE REVIEW

Computer Numerical Control (CNC) machines are broadly used in manufacturing industry. Conventional machines such as vertical millers, centre lathes, shaping machines, etc. operated by a qualified engineer.
cases, have been replaced by computer control machines. Since the rise of the CNC (Computer Numerical Control) machines introduction in the machining sector, they have been praised for being precise, fast, reliable and flexible. Although CNC machines are not entirely independent, a lot of major industries depend on thesamarvel machines. Common CNC-dependent industries include the metal industry and the woodworking industry. Productivity as well as quality both has a similar impact on final product. In this research work, milling experiments are carried out on Mild Steel. Full factorial experimentation is adapted for conducting pilot experiments to study the effects of cutting parameters on machining time and roughness. Empirical relations for surface roughness have been developed for the proposed Mild Steel material based on pilot experiments. Then, Particle Swarm Optimization (PSO) technique was implemented for predicting optimum cutting parameters for any desired roughness in minimum machining time. Most of the research work ends up here without validating the optimal cutting parameters. However, most importantly, in this research work, validation experiments are conducted as per the optimized parameters obtained by PSO. The predicted values of machining time and roughness obtained by PSO are compared with experimental results. It is found that the predicted values are in good agreement with the measured machining time and roughness. The findings of the present work infer that the use of the proposed methodology can greatly replace the laborious process of selection of cutting parameters by trial and error method. This will reduce the wastage of resources used for manufacturing. Due to this, production cost and selling cost of the component can be reduced; hence sales and profit for the industries can be improved to a great extent[4].

This paper discuss of the literature review of optimization of milling machining process parameters for composite materials. Machining process has characteristics that describe their performance relative to efficient use of machine tools by setting optimum cutting parameters. The traditional optimization techniques are not suitable because milling machining operation is highly constrained in nature[8]. Due to the urgent need for global reductions of environmental impacts, many studies have been carried out in different fields. One of the most important sectors is manufacturing, particularly due to the highpower consumption of the production machines of manufacturing plants. This paper focuses on the efficiency of the machining centers and provides an experimental approach to evaluate and optimize the process parameters in order to minimize the power consumption in a milling process performed on a modern CNC machine. The parameters evaluated are the cutting speed, the axial and radial depth of cut, and the feed rate. The first important result is that the idle or basic state constitutes the larger component for the power consumption of the machine; this result is also demonstrated by many other papers in the literature. This characteristic of the machine could be used by machine tool manufactureres to design more efficient machining processes; first steps could be the reduction of the time during which the machine stays in the ready state, the reduction of the moving mass of the machine[10].

Manufacturing technologies are currently defined as on basics of adoptability, autonomous production, and level of automatization. As we modernize the manufacturing lines, subsequently we are required to update and integrate most modern technologies in order to keep the business competitive. In such way, we can assure cheaper products, shorter manufacturing times, lowering of the production costs. Due to the dynamic processes and increase of the machining parameters optimizing the information which is essential for production got significantly harder. For solving such problems, we have to turn our choice onto the intelligent methods, such as Particle swarm optimization or similar type of intelligent optimization. In this paper we present a proposal, how to successfully gain optimal cutting parameters – cutting speed, feedrate and cutting depth for certain requirements such as cutting force, surface finish – roughness and cutting tool life. The presented paper serves us for initial step into optimizing methods and it shows an elementary approach to solving machining optimization parameters. Despite its purpose for certain material, the code could get adopted for broader spectrum of parameter optimization, which means we could eliminate the factor of material in order to gain an optimization algorithm capable of optimizing parameters for different materials[15]. Milling is one of the progressive enhancements of miniaturized technologies which has wide range of application in industries and other related areas. Milling like any metal cutting operation is used with an objective of optimizing surface roughness at micro level and economic performance at macro level. In addition to surface finish, modern manufacturers do not want any compromise on the achievement of high quality, dimensional accuracy, high production rate, minimum wear on the cutting tools, cost saving and increase of the performance of the product with minimum environmental hazards. In order to optimize the surfacelfinish, the empirical relationships between input and output variables should be established in order to predict the output. Optimization of these predictive models helps us to select appropriate input variables for achieving the best output performance. In this paper, four input variables are selected and surface roughness is taken as output variable. Particle swarm optimization technique is used for finding the optimum set of values of input variables and the results are compared with those obtained by GA optimization in the literature. There is lot of scope for application of particle swarm optimization (PSO) for these kinds of problems by taking more number of input variables. It will be interesting...
to see the results for greater number of variables and trying various combinations of variables. As the recent trends in research is in the area of micro manufacturing process like micro grinding, micro milling, micro drilling and laser application, application of PSO will help the industrialists to find the optimum values of input variables and work for longer periods without changing the manufacturing set up. The work can also be extended by taking output variables such as, material removal rate (MRR), production cost etc., in addition to surface roughness [20]. Machining of thin-walled parts is a key process in aerospace industry. Many components used in the aerospace industry are usually thin-walled structures. Because of their poor stiffness, thin-walled work pieces are very easy to deform under the action of cutting force in the process of cutting. Even in CNC milling, in which the tools are controlled exactly according to the contour of the thin-walled component, the wall will be thicker at the top and thinner at the root. In general, the surface dimensional error is induced mainly by the deflection of the work piece during milling, which does not remove the material as planned. The part deflection caused by the cutting force is difficult to predict and control. The main objective of this work is to achieve the minimum surface dimensional error which decreases the machining time. Therefore, the cutting parameters are to be optimized which enables the minimum possible surface dimensional error. The conditions required to achieve this in high speed milling process imply optimum cutting forces which in turn induce the part deflection. The present work is aimed at predicting cutting forces during machining and obtaining optimum cutting speed and feed rate. An Artificial Neural Network (ANN) predictive model is used to predict cutting forces during machining and Particle Swarm Optimization (PSO) algorithm is used to obtain optimum cutting speed and feed rate[22]. In this paper, Particle Swarm Optimization (PSO), which is a recently developed evolutionary technique, is used to efficiently optimize machining parameters simultaneously in high-speed milling processes where multiple conflicting objectives are present. This study has presented multi-objective optimization of end milling process by using neural network modeling and Particle swarm optimization. A neural network model was used to predict cutting forces during machining and particle swarm optimization was used to obtain optimum cutting speed and feed rate. PSO algorithm is used to optimize both feed and speed for a typical case found in industry. Both feed and speed were considered during optimization. The experimental results show that the MRR is improved by 28%. Machining time reductions of up to 20% are observed [25]

V CONCLUSION

Here we have offered the concept of PSO and work conceded out on PSO by different researchers. A thorough literature review is presented which is used to get out the limitations in different method and which gives opportunity for future scope. Future scope identifies as effort to be carried out towards topology of communication, parameter adjustment, initial distribution of particles and methods to deal with any inactivity. Optimization of process parameters helps the organization to obtain valuable effect of machining. The number of process parameters chosen for exact study work may entitle many appropriate optimization techniques

REFERENCES


