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A REVIEW ON OPTIMIZATION TECHNIQUES OF VARIOUS MACHINING PARAMETERS OF MILLING MACHINE

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ABSTRACT

Machine parts are greatly influenced by the surface quality during their useful life and productivity also plays an important role in the existence of any product in market. In order to achieve that, process parameters should be suitably regulated.The paper shows a review about the optimization of various parameters of milling operations such as cutting speed, feed, depth of cut, vibration, materials and materials sizes.Paper shows minimum surface roughness, minimum time and minimum cutting force , can be obtained by using several optimization techniques.

KEYWORDS: Surface Roughness, Taguchi Methods, Vibration Tool, RSM (response surface methodology), GA (Genetic Algorithm),FEA Finite Element Analysis), ACO (Ant Colony Optimization).

INTRODUCTION

Milling is a cutting process that uses a milling cutter to remove material from the surface of work piece. Milling cutter is a rotary cutting tool often with a multiple cutting points. Surface roughness is often a good predictor of performance of mechanical component. Large number of machining operations and the factors that influence each operation leads difficult to develop models for predicting the cutting phenomenon. Various methods are employed to solve the same difficulties mentioned below.

Taguchi method involves reducing the variation in process through robust design of experiment.
A Genetic Algorithm is a method for solving both constrains and unconstraint optimization problems based on natural selection process that mimics biological evolution. Response Surface Methodology (RSM) is a collection of mathematical and statistical techniques for empirical building. By careful design of experiments the objective is to optimize output variable.

Finite Element Analysis (FEA) is a computerized method for predicting how a product reacts to real world forces, vibration, heat, fluid flow and other physical effects.Ant colony optimization (ACO) is probabilistic technique for solving computational problems which can be reduce to finding good paths through graphs.

WORKING PRINCIPLE OF MILLING MACHINE

The work piece is holding on the worktable of machine. The table movement controls the feed of work piece against the rotating cutter. The cutter is mounted on the spindle or arbor and revolves at high speed. Except for rotation, the cutter has no other motion. As the work piece advances, the cutter teeth remove the metal from the surface of work piece and desired shape is produced.

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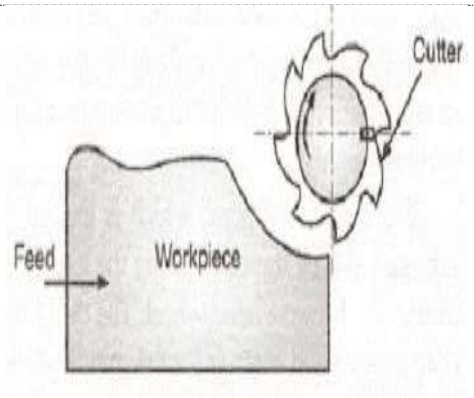

Fig. 1 working principle[9]

The main part of machine is Base, Column, Knee, Saddle, Table, over arm, Arbor Support and Elevating Screw.

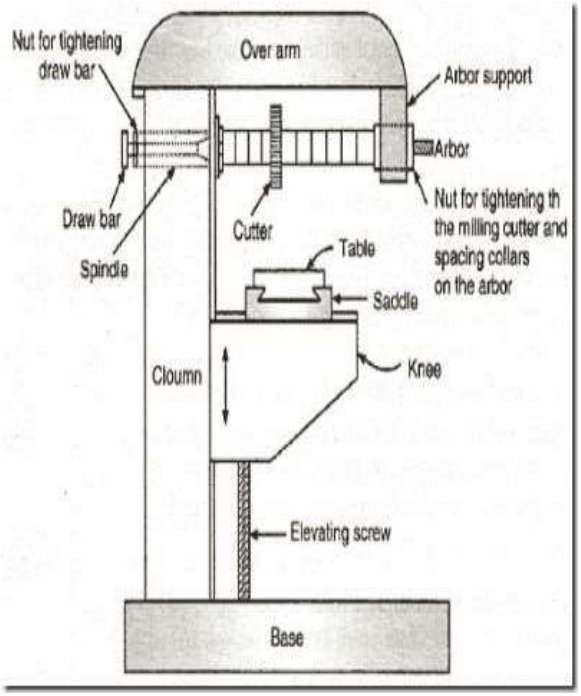

Fig. 2 Horizontal Milling Machine

LITRATURE SURVEY

Hedi Yangui, Bacem Zghal, Amir Kessentini, Gael Chevallier,Alian Riviere, Mohamed Haddar, Chafir Karra (2010) Carried out experimental investigation on influence of cutting and geometrical parameters on the cutting forces in milling.In this work it has been graphically shown the influence of parameters by changing various tool geometries on cutting forces and feed .

The second relation between two parameters has been shown as Cutting force increases when cutting depth increases.It has been shown the variation of cutting forces with parameters such as beginning angle, number of teeth ,up milling, down milling.

R Ashok Raj, T Parun , K Sivaraj And T T M Kannan(2013) carried out experiment on optimization of EN8 steel using Taguchi methodology(EN8 steel finds many applications in manufacturing of parts such as axle, shaft gear and fasteners due to their high tensile property)

A 50 mm and 12 mm thickness EN8 steel flat plate has been used in experimental investigation.

The paper says that cutting speed is statistically significant factor influencing the surface roughness in milling process.Lowest surface roughness is obtained at cutting speed 285 m/min, feed rate of 0.27 mm/rev and depth of

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cut 0.4 mm.Side and face milling cutter is suitable for machining EN8 steel which produced good surface finish with required accuracy.

Baskar.N ,Kannan.S. (2013) Performed experiment on modeling and optimization of face milling operation based on response surface methodology and genetic algorithm. The experiment is conducted based on L27 orthogonal array with respect to full factor design. The three factors and each three levels with two replicates were considered base on machine tool specification and tool manufacturer's recommendation. Aluminum has been used as work piece material with size of 32mm cube. Diameter of tool was 50 mm and tungsten carbide insert is used named as APMT-16.

It has been concluded that for better surface finish the maximum level of feed and depth of cut is recommended, and hybridization of RSM and GA is effective methodology for optimization of machining parameters.

Ayman A. Abuniza(2013) In this paper,Thermal error modeling of three axes vertical milling machine using finite element analysis (FEA) FEA technique used to reduce thermal error up to 90% and roughness from 35 µm to within 4 µm .

FEA is carried out to predict temperature gradient and spindle thermal deformation which effects on surface roughness. This paper present FEA method of predicting thermal errors in a small VMC. Experimental work conducted to obtain thermal behavior of machine structure by running spindle, recording temperature gradient and displacement data.

The predicted temperature rise and displacement data from simulation fit the experimental data.
FEA is used to predict errors under different operating conditions and to develop compensation model.

K. Kadirgrama (2010) RACO (Response ant colony optimization) of end milling surface roughness. This paper presents optimum surface roughness by using milling mould aluminum alloy (AA6061-T6) with RACO. This paper is based on RSM and ACO. The main objective to find the optimized parameters and most dominant variables as cutting speed, feed, axial depth and radial depth it shows that feed rate is most significant factor affecting the surface roughness. It showed the use of RACO to formulate an optimized minimum surface roughness prediction model for end machining of A6061-T6 .This prediction model is tested on validation experimental and the error analysis of the prediction result with measured result is estimated at 4.65% for minimum surface roughness.

Simulation result showed that ACO combined with RSM can be very successfully used for reduction of the effort and time required.

Vytautas Ostasevicius-Rimvydas Gaidys-Rolanas Dauksevicius-Sanra Mikukyte(2013) Studied the vibration milling for improving Surface Finish of Difficult to cut Materials. This work studied the influence of high frequency excitation of a cutting tool during end milling of work pieces made of difficult-to-cut metallic alloys. The main properties of FE models are : cutter length =96 and 74 mm,
Diameter=10mm, density=207GPa, poisons Ratio=0.3.

Experiments were carried in CNC milling center with workpiece made up of stainless steel (1.4301) and titanium (GOST 22178-1976)without using cooling lubricant. The paper have shown the reduction in the surface roughness of 21.54% and 6.33% in steel and titanium respectively when 74 mm cutter length is used and reduction in surface roughness of 22.59% and 12.54% in steel and titanium respectively when 96 mm cutter length is used.

Abdulla Altin(2013) Studied the effect of Cutting Speed on the Cutting Forces and Surface Finish when milling chromium 210Cr12 Steel Hardfacings with Uncoated Cutting Tools.

The experiment study presented in this paper aims to select the most suitable cutting and offset parameter combination for a milling process in order to obtain the desire surface roughness value for a machine workpiece of chromium 210 Cr12 steel , in terms of cutting speed , feed rate depth of cut for the milling process.
The machining tests were performed by single point milling of this material in flat form with dimension of 100mm × 50mm ×30mm. The milling test were conducted with uncoated cemented carbide cutting tools. It says that

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increasing cutting speed by 85.7%,(70-130m/min) causes the main cutting force to decrease by 13.1%, and increasing the cutting speed by 57.1% causes the cutting force to decrease by 13.75%, the minimum cutting force value of 212 N was obtained at a cutting speed of 110 m/min.

CONCLUSION

From literatures survey, a lot of research has been done on process parameters like cutting speed, feed, depth of cut, materials and its dimensions on CNC. From investigation survey maximum level of cutting speed with minimum level of feed and depth of cut is recommended for better surface roughness. The mostly used technique is Taguchi method but other methods such as hybridization of RSM and GA is also effective. The investigation shows percentage decrease in surface roughness of different materials like EN8 steel, stainless steel, titanium, chromium can be obtained by using different combination of cutting speed, feed rate and depth of cut via different software technologies.It has been shown that minimum surface roughness can be maintained by using vibration tool.

In this paper we investigated influence of various optimization parameters on surface finish which can be used in industries in order to select most suitable parameters combination in order to achieve the required surface finish.

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