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Prediction Of Process Parameters In Machining Of Aluminium Alloy 6067 Using Central Composite Design And Genetic Anlaysis

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Abstract-Aluminum alloys are widely used for difficult structural applications due to fine combination of mechanical properties, corrosion resistances and formability. Hence the current work is about machining of aluminum alloy at various combinations of process parameters such as speed , feed rate and depth of cut and to determine the effect these parameters on surface quality. The speed vary from 100m/min to 200m/min, depth of cut range was 0.25 mm to 1mm, feed range was 0.05 mm/rev to 0.1 mm/rev. 3^3 full factorial design of experiments will be followed in this research work.

Keywords-corrosion resistance,optimization,Design,material,operating parameters

I. INTRODUCTION

About the Machining, the most widespread process for influential metal, has develop into a very significant aspect of modern society and manufacturing industry. The importance of the machining process is evident by the study that nearly every device used by humanity in day-to-day life at least one machined part or surface. Weight reduction materials is become increasing important, especially in the aerospace industries and automobile industries.

A. Project Objective

The aim of this project work is to study the machining effect on 6067 Aluminium alloy at varies combinations of process parameters such as speed, depth of cut and feed rate ; and also to determine the effect of those parameters over the quality of completed product. A 3^3 Orthogonal Array (OA) based Design of Experiments (DOE) approach and Genetic algorithm was used to analyse the machining effect on work material in this study. use the sensible data obtained, a mathematical model is residential to predict the temperature influence and surface quality of finished product. The definitive goal of the study is to optimize the machining parameters for temperature minimization in machining zone and improvement in surface finish.

B. About The High Speed Machining

The demand for high speed machining (HSM) of various materials including aluminium alloys is increasing, in order to improve productivity and to save machining cost. High speed machining was first report in 1931 by C.Salomon. He is known as the inventor of HSM and accomplished that machining temperatures start decreasing above a certain cutting speed. The definition of HSM is dependent on the work piece and tool materials concerned. HSM can mean high cutting speed (V), high rotational speed (N), high feed rate (f) and high productivity. High speed machining for a given material can be defined as a speed above which shear localization develops completely in the primary shear zone. High speed machining is used in the defences, aerospace and automobile industries. Most aerospace manufacturers have implemented high speed machining in turning using small size inserts, and since the most common material is aluminium.

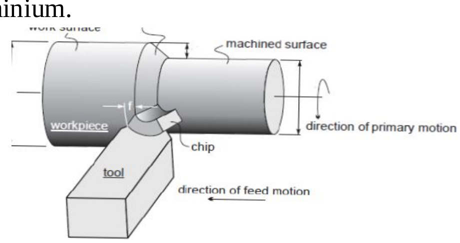

Figure 1.1 Machineing Process

C. Optimization Method Based On Genetic Algorithms

Optimization problems are often extremely non-linear, stiff, multiextreme and non-differential. The lack of a single method available to deal with multidimensional problems, including those with some goals to optimize, has generated the need to use numerical processes for optimization. This paper presents a method of global optimization based on genetic algorithms. The Genetic Algorithms are a versatile tool, which can be applied as a global optimization method to problems of electromagnetic engineering, because they are easy to implement to non-differentiable functions and discrete search spaces. It is also shown how, in some cases, genetic algorithms have been applied with success in electromagnetic problems, such as antenna design, far-field prediction, absorber coatings design, etc.

D. What Is The Gentic Algorithms

The genetic algorithms (G.A.) are typically characterized by the following aspects

The G.A. work with the base in the code of the variables group (artificial genetic strings) and not with the variables in themselves.

The G.A. work with a set of potential solutions (population) instead of trying to improve a single solution.

The G.A. do not use information obtained directly from the object function, of its derivatives, or of any other auxiliary knowledge of the same one.

The G.A. applies probabilistic transition rules, not deterministic rules.

The genetic algorithm process is quite simple; it only involves a copy string, partial string exchanges or a string mutation, all these in random form.

E. The Object Function

Frequently design problems have to comply with norms or practical constraints that either optimize cost or design performance. In general, they should cover goals for good global performance. These goals do not always match, i.e., while one goal requires the maximum of a parameter, another goal requires the same parameter to be as small as possible. Optimization goals can be expressed in a more dependent mathematical relationship form of a parameter group or design variables of which these parameters in turn can be constraints to interval values. The mathematical expression that represents the optimization goal is commonly known as the "object function".

II. PROBLEM IDENTIFICATION

Misalignment of couplings, bearings and gears

Unbalance of rotating components

Deterioration of rolling-element bearings

Rubbing

Resonance

III. SOLUTION DEFINED

Solution it can be applyed The machining temperature and forces to be measured is addressed, as well as the methods used to do so. The basic data acquisition techniques, as well as the methods of implementing them are covered. The necessary instruments for force and temperature measurement as well as data acquisition are selected. A basic overview is given on how the various instruments work, as well as their characteristics and specifications note it.

A. Select The Machining Tool

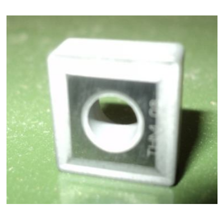

Figure 1.3 Turning inserts THN SNMG 08Maching Tool

Turning insert tool are effective for producing a corner radius between a wall and a floor on a given part feature. They also add to

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the strength of a turning inserts. When machining hard, tough to cut materials, the sharp corners on a standard turning insert tend to chip and wear provides a more gradual shearing entry in to the work piece.

B. Select The Work Piece & Material Properties With Specifications

The work piece material used for the centre lathe turning operation was a cylindrical piece of size 320 × 60mm. The material of the work piece is 6067 Aluminium Alloy [ASTM -STD]

Figure 1.4 Work piece material

Table 1.3 Mechanical Properties of 6067

Ultimate tensile strength	293MPa
Yield strength	265MPa
Poisson's ratio	0.35
Fatigue strength	156MPa
Shear strength	174Mpa

C. Composition Of Material Alloy

Table1.1 Chemical Composition of 6067 in % by Weight:

Si	Fe	Cu	Mn	Mg	Zn	Ti	Cr	Al
0.5	0.4	0.1	0.7	4.5	0.1	0.1	0.1	Balance

Table1.2 Chemical Composition mechanical properties:

Property	Value
Density	2.72 kg/m^3
Melting point	590°C
Modulus of elasticity	85 GPa
Electrical resistivity	0.065 * $10^{-6}\Omega$m
Thermal conductivity	120 W/mk
Thermal expansion	25*10^{-8}/k

IV. CAUSE STUDY ANALYSIS USED MEASUREMENT

A. Tool-Work Thermocouple

Thermocouples are known to be very popular transducers for measuring temperature. The inserted k-type thermocouple shown in Figure 3.1 was chosen for measuring the temperature in this project work.

Figure1.5 K-Type Thermocouple with Digital micro voltmeter

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B. Force Measurement

The forces in machining can either be measured directly or indirectly. When measuring forces directly during the turning process a tool is mounted on a dynamometer. The dynamometer is said to respond to the forces by creating electrical signals in proportion to them, the device can give accurate values for the forces in both magnitude and direction. Indirect measurements involve deduction from the machine tool behaviour, for instance, the power used by the main spindle motor increases with the main cutting force or the torque. The direct measuring technique is preferred for this project work.

C. Dynamometers

There are various types of dynamometers that are used to measure machining forces. The most popular dynamometers are strain gauge dynamometers, octagonal dynamometers, parallel beam dynamometers, piezoelectric dynamometers and split tool dynamometers. Piezoelectric dynamometers will be the main consideration in this project work.

D. Charge Amplifiers

The Kistler quarts three-component dynamometer is connected to three Kistler multichannel charge amplifiers which is shown in Figure 3.3 and it is using a highly insulated connection cable. The amplifiers amplify the electrical charges delivered from the dynamometer into proportional voltages that can be displayed as proportional forces.

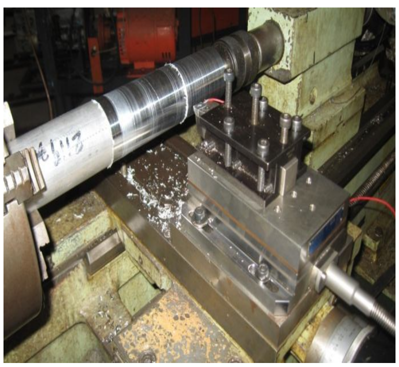

Figure 1.6 Kistler three components Dynamometer fitted with tool holder

Figure 1.7 Multi Channel Charge Amplifier

Figure 1.8 Surface Roughness Tester

E. Surface Finish Measurement

The surface finish in machining can be measured directly. When measuring surface finish directly, a surface roughness tester shown in Figure 3.4 is placed over the finished product. It has stylus probe to read the surface finish with in the specified distance. The distance to be moved by the probe can be set by the operator. Three types of λ values can be given and the lambda represents

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distance to be moved.

V. RESULT AND DISCUSSION

Expermental cause study and analysis of the results and discussion given the table 1.4.

Table 1.4 result and Discussions[Expermentally]

TRIAL.NO	SPEED IN RPM(N)	FEED	DEPTH OF CUT	TOOL WEAR			CUTTING FORCE			SURFACE FINISH	
				Initial	Actual	Final	Fx	Fy	Fz	Ra	Ra/z
1	300	0.15	2	9.12	9.14	0.02	999.97	1132.9	911.5	2.58 2.65 1.71	27.5 16.4 15.3
2	300	0.10	1.25	9.34	9.37	0.03	684.66	825.54	1026.58	1.30 1.65 2.17	6.0 13.5 6.7
3	300	0.05	0.5	9.06	9.09	0.03	170.61	89.68	120.57	0.96 0.84 1.16	7.6 7.5 10.0
4	600	0.05	1.25	9.31	9.35	0.04	307.53	127.81	185.26	1.41 1.38 1.78	7.1 7.2 8.5
5	600	0.10	2	9.29	9.32	0.03	634.87	822.14	962.45	0.83 0.73 0.80	5.3 5.2 4.7
6	600	0.15	0.5	9.41	9.48	0.07	296.27	299.93	292.65	3.72 3.48 3.62	22.3 21.9 31.8
7	900	0.5	2	9.40	9.43	0.03	75.9	71.09	137.1	1.08 1.05 0.99	6.8 6.5 5.4
8	900	0.10	0.5	9.41	9.43	0.02	154.82	310.13	293.2	0.79 0.71 0.82	4.7 4.8 5.4
9	900	0.15	1.25	9.47	9.49	0.02	436.84	610.13	654.28	0.96 0.93 1.13	6.7 6.9 6.0

VI. CONCLUSION

In this project, Aluminium alloy 6067 is selected as work piece material and tungsten carbide is a insert tool is used for machining Machining is carried out by using the conventional lathe and cutting forces are taken by using of the kistler dynamometer, surface finish values are taken by using of surface roughness tester, tool wear are taken by using of the tool maker microscope and longitudinal microscope.The various input parameters considered are feed rate, depth of cut and speed in three levels i.e, low, medium, high 9 set of output reading have been taken. Thus the project is concluded by a 9 set of experimental values.In future there set of output values will be analysed by using of design of expert software and orthogonal array will be achieved.From that optimised composite design will be arrived using a the genetic algorithm.

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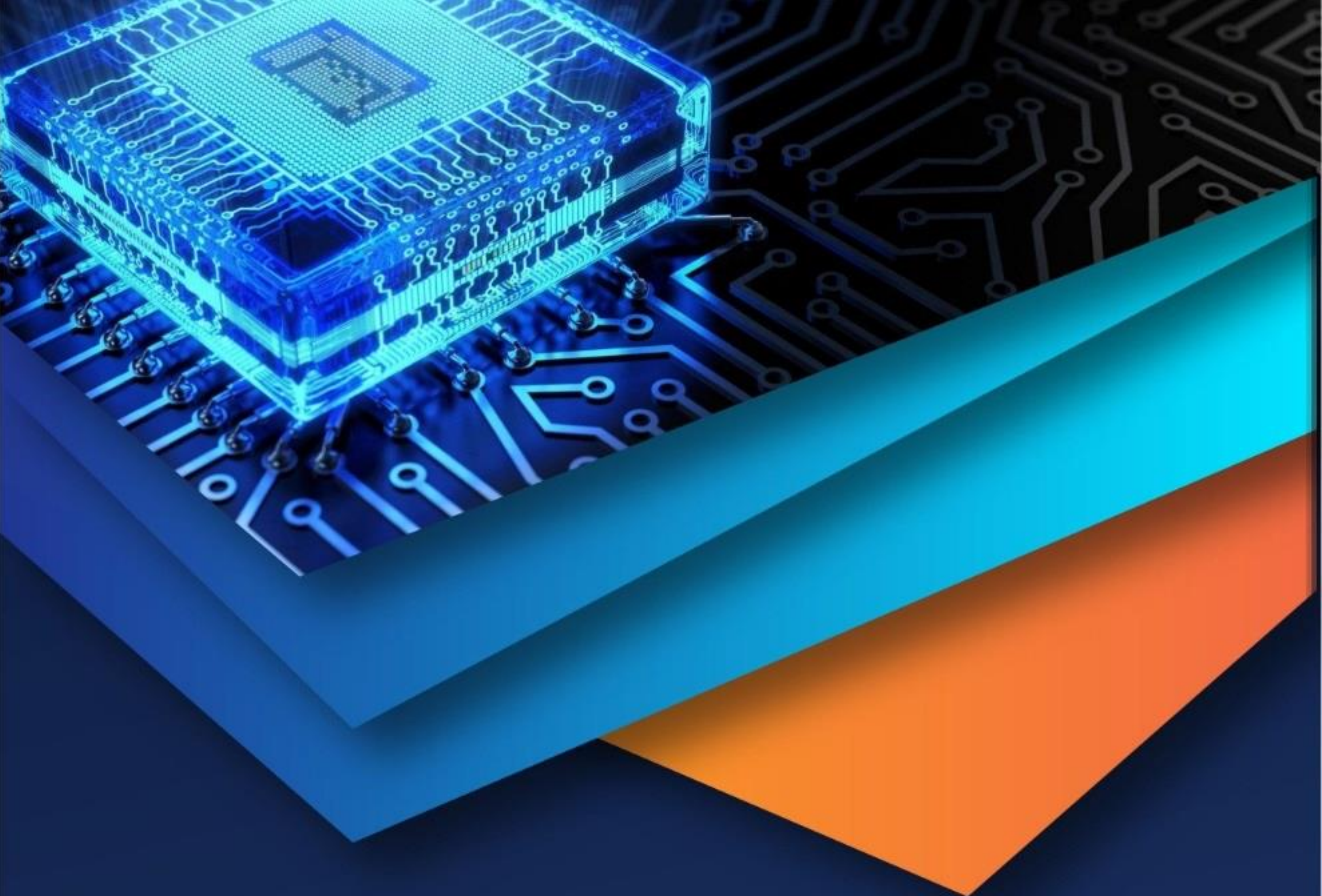

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