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INFLUENCE OF CUTTING PARAMETERS ON THRUST FORCE AND TORQUE IN DRILLING OF ALUMINUM AND EN31

Nuggu Jagadeesh
P.G. Scholar
Sri Venkateswara Institute of Technology, Anantapuram, Andhra Pradesh, India

Mr. N. Phani Raja Rao
Assistant Professor & HOD
Sri Venkateswara Institute of Technology, Anantapuram, Andhra Pradesh, India

D. Madhu Sree
Assistant Professor
Sri Venkateswara Institute of Technology, Anantapuram, Andhra Pradesh, India

ABSTRACT

In recent years, aluminum-matrix composites (AMCs) have been widely used to replace cast iron inaerospace and automotive industries. Machining of these composite materials requires better understanding of cutting processes regarding accuracy and efficiency. This study addresses the modeling of the match inability of self-lubricating aluminum /alumina/graphite hybrid composites synthesizing by the powder metallurgy method. In this study, multiple regression analysis (MRA) and artificial neural networks (ANN) were using to investigate the influence of parameters on the thrust force and torque in the drilling processes of self-lubricating hybrid composite materials. The models are identify by using cutting speed, feed, and volume fraction of the reinforcement particles as input data and the thrust force and torque as the output data. A comparison between two prediction methods is developing to compare the prediction accuracy. Here we are finding the spindle speed is insignificant or significant, it directing us to set it either at the highest spindlespeed to obtain high material removal rate or at the lowest spindle speed to prolong the tool life depending on the need for the application.

Keywords: Artificial Neural Network; Metal-Matrix Composites (MMCs); Multiple Regression Analysis; Statistical Methods; Machining, EN-31

INTRODUCTION

First-stage manufacturing procedures include casting, rolling, forging, welding, etc. Preparatory operations produce components that don't meet occupational tolerances. Several secondary techniques can be used with machining to generate accurate components.

Four machining operations are turning, milling, grinding, and drilling. Chips of material are removed during machining. As the last stage before assembly, drilling is crucial. Component assembly requires drilling, not welding, riveting, etc. This article analyses drilling parameters for different materials. Due to their electrical qualities, automotive and aerospace sectors study copper, brass, stainless steel, titanium, and composites.

Modern businesses need cost-effective machining. Academics have devised mathematical models for the derived unit. Process planning engineers use mathematical models of machining parameters to determine the desired output.Researchers from all around have used response surface methods to model the drilling process for optimal efficiency. The best parameter can be chosen efficiently if the time and money spent on research are reduced. Also not that, but a wide range of drilling methods were put to use. We'll start with #1: fuzzy logic. Synaptic synapses Very few researchers have moved away from response surface research in favour of fuzzy logic and neural network approaches.

This work models the drilling process using fuzzy logic, neural networks, and response surfaces, and compares their performance to actual data. The idea of experimental design has been incorporated in the experimental technique. Avoiding iterative, inefficient "trial-and-error" experiments is a primary goal of the design-of-experiment idea. To cut down on the time and money spent on experiments, the use of fuzzy logic is being explored.

The neural network that keeps an eye on drilling operations. Finally, experimental data was used to verify the accuracy of the produced models and to propose how well these modelling techniques would work in practise for maximising the success of a drilling operation. These days, traditional and CNC 3 drilling processes are used by every manufacturing industry to create holes in the faces of components. Drilling operations on both machines benefit greatly from research into machining settings. So, the mathematical models for both machines are refined here, taking into account a wide range of materials used in the work pieces.

The class of engineered materials known as metal-matrix composites (MMCs) has been the subject of extensive study. SiC, Al2O3, and Graphite are the most widely used reinforcements. In many cases, the matrix phase is an alloy of aluminium, titanium, or magnesium. Metal-matrix composites (MMCs) are superior to monolithic materials due to their superior specific strength, greater thermal conductivity than ceramics, good wear resistance, and lower thermal expansion coefficient [1–5]. MMCs.

numerous aerospace and automotive applications utilising super-alloys, ceramics, polymers, and modified steel parts. Because of this, the past 30 years have seen a surge in research and development efforts dedicated to composite materials. The goal of making composite materials is to gain qualities that are not available in the individual components..

Although near net form manufacturing has been developed for these goods, they still require finishing before they can be assembled. However, further machining procedures like drilling are required for assembling and connecting. In many cases, drilling is the final step in the production process before a part is ready for assembly.

The automotive, aerospace, dies/molds, white-goods, medical, and electronic equipment industries are just few of the many that regularly employ drilling as their primary machining method. For the most part, a drill is used in a drilling operation to bore a hole through a component's face and into the component's interior. When the drill bit touches the material, the drilling process officially begins and the penetration phase evolves into the full drilling phase (Arul et al 2006).

As a rule, drills have two cutting edges: the main one and a secondary one used for chiselling. The majority of the cutting action is performed by the primary cutting edge. The material is then severely plastically distorted by indentation and edge rotation while doing the work. Moreover, other studies have found that drilling has two distinct effects when it comes to creating a hole: I the indentationof chisel edge, and ii) the cut of the major edges (Singh et al 2008). In terms of economic significance, drilling ranks high among the many milling because it is typically one of the last steps in the production of mechanical parts (Arshinov& Alekseev 1976). But the drill accounts for a quarter of all machining time (Sanjay Rawat&HelmiAttia 2009). To stay competitive in today's market, drilling processes need to reduce their cycle times. Moreover, tight geometric tolerance requirements in design sdeman

The cutting tool contained in the spindle rotates as the principal motion in drilling and reaming. The secondary feed motion is likewise carried out by drills and reamers. Some reaming processes for fine-tuning are done by hand.

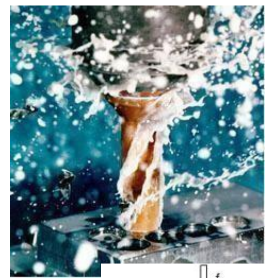
Cutting conditions in drilling:

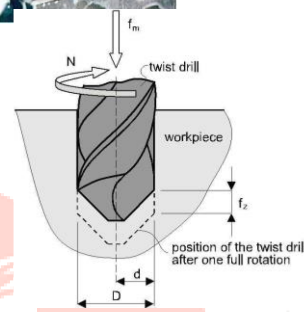
The twist drill is a cutting tool that takes a little chip of material from each of its two evenly opposed cutting edges.Feed per minute (fm): Feed per minute is computed with rotating N

LITERATURE REVIEW

The preceding chapter introduced the concepts of

PMC, monitoring the drilling of FRP laminates, and ANN. Over the past few decades, PMCs have found more uses, particularly as CFRP utilisation in the aerospace industry has grown significantly. Since CFRP composite is one of the most modern materials, its specific strength and modulus are superior to those of more traditional materials. Consequently, the use of CFRP as a structural material has increased. An important and relevant topic in contemporary manufacturing process research is the machining of CFRP composite materials (Sardinas et al. 2006). Due to the fact that CFRP is a polymer matrix composite material, secondary machining operations present significant difficulties. Drilling, sawing, trimming, and grinding are a few of the final machining operations.Due to the requirement for linking structures, drilling is the machining operation that is used the most frequently with fibre reinforced materials. Because their carbon fibre reinforcing is anisotropic, non-homogeneous, and very abrasive,





drilling CFRP is challenging. Poor hole quality in the aerospace sector is thought to be the cause of 60% of all part rejection (Hocheng and Tsao 2006). Researchers are looking at ways to optimise the drilling process due to the growing use of carbon composites in industry and the continual requirement to maximise efficiency.

METHODOLOGY

MATERIALS:

Property	Value
Density (kg/m3)	2700
Melting point (°C)	660
Thermal conductivity (W/m°C)	220
Coefficient of linear expansion at 20°C (µm/m/°C)	23.0

Table 3.1

Advantages

It has similar corrosion resistance to copper.

It is a very good heat and electric conductor, though not quite as good as copper.

Is extremely ductile and light, which makes it popular in the aircraft industry.

Since cold working makes objects hard, it requires continuous annealing.

Applications

Transportation (automobiles, trucks, aeroplanes, trains, boats, bicycles, spaceships, etc.) in the form of sheet metal, tubes, and castings.

- The packaging (cans, foil, frame of etc.).
- Food and beverage containers due to their corrosion resistance.
- Development (windows, doors, siding, building wire, sheathing, roofing, etc.).
- A variety of home goods, including baseball bats, watches, and cooking utensils.
- Walking poles, sailboat masts, and street lighting poles.

The outside casings and covers for consumer gadgets and camera gear.Power lines ("creep" and oxidation are not issues in this application as the terminations are usually multi-sided "crimps" which enclose all sides of the conductor with a gas-tight seal).

Alnico and MKM magnets.Super-pure aluminum (SPA, 99.98% to 99.999% Al), utilized in cables and cable construction as well as in electronics and CDs.

Heat sinks for CPUs, transistors, and other electrical appliance parts.

Property	Value
(kg/m3) Density	7810
°C, melting point	1540
(W/m°C) Thermal conductivity	466
Coefficient of linear expansion at 20°C	32.12

Table 3.2

Advantages

It's strong per mass. Even for large structures, steel elements are small, saving space and improving aesthetics.

- Environmental friendly issue
- • Excellent wear resistance and very high surface hardness

- Cost efficiency
- Energy Efficiency
- Time saving
- It has assured quality and high durability. Sustainable, durable and safe with exceptional resistance to fire, corrosion and pests.

Applications

Tools for spinning, beading rolls, punches, and dies, Tools for spinning, for industrial use..

Multiple Regression Analysis

Regression analysis investigates variable relationships. The investigator usually seeks to determine causality. Multiple regression analysis (MRA) is widely used to model input-output relationships. Regression measures the average relationship between two or more original variables. Regression reveals variable cause-and-effect.. In regression, cause is independent and effect is dependent.

Artificial Neural Networks (ANN) :

AI modelling methods include ANNs. They are made up of basic processing units called neurons that are stacked in layers and have highly linked architectures similar to those of human brain cells. Artificial neural networks, which are formed of basic processing units and comprise enormous parallel distributed processors, can store and apply experimental information. It resembles the brain in two ways: The network picks up knowledge from its surroundings and saves it in interconnection weights..

Measurement of Thrust Force and Torque :

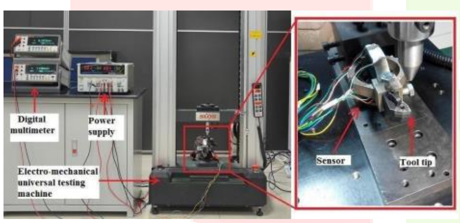
Figure shows thrust and cutting torque. BKM 2000 TeLC monitors drilling thrust and cutting torque. TeLC cutting tool dynamometers with serial PC interface were read by XKM 2000.

ANN uses backpropagation feed-forward. The cutting force models use Al2O3, Gr, cutting feeds (f) and spindle speeds (N) as inputs and thrust force and cutting torque as outputs. A 4-10-2 ANN was used (thrust force and torque).

ANN nodes require [0,1] inputs. Formula used to alter input data:

ANN output values were also in the range [0,1] and translated using reverse normalization.

To create training, validation, and testing datasets, all 81 machining conditions were randomly divided. The network was constructed using 57 (70%) of the data points from the training set.12 points (15%) were used to assess the neural network's generalization. The hidden layer transfer function is sigmoid activation and the output layer is linear. After several attempts, 0.03 and 0.9 were chosen for learning rate and momentum. ANN was trained using Levenberg-Marquardt. After 106 rounds of training, testing, and validation, error reduction was insignificant. MSE=0.00182 A simple architecture can be employed effectively without sacrificing prediction accuracy.



Fiure3.2: Experimental setup with sensor arrangements

RESULTS AND DISCUSSION

Experiments have been used to study the thrust force and torque produced by the composite under discussion during the drilling process in order to determine the effects of one or more variables, including cutting speed, feed, and the volume fraction of the reinforced particles. When there are two or more variables in an experiment, the variables may affect the result either directly or indirectly.

In general, experimental designs do not offer insight into the interaction effects of the factors, in contrast tone-factor at a time finding. Split plot studies with all conceivable factor level combinations can be used to examine the interaction effect of the factors. Completely random designs are appropriate when the testing is not restricted in any way to prevent systematic biases.

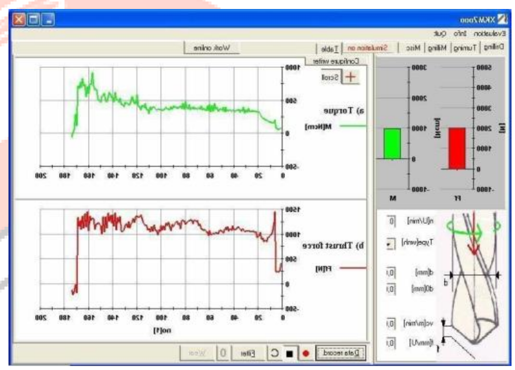


Figure4.1 . machinability charts: (a) torque; and (b) thrust force.

Multiple Regression Analysis Results:

The software programme MINITAB 15 was utilised to conduct the multiple regression analysis utilising the above experiment data in order to create the prediction model.First, regression models were created and tested for predictability. Tables demonstrate thrust force and torque linear regression models. The linear regression model works effectively in thrust force analysis based on R2 and R2(adj). R2 = 77.8% and R2(adj) = 76.6% indicate inadequate torque model detection. Due to this problem, we linearize outputs before performing linear regression. This removes the residuals variance inequality with time, as illustrated in Figures (Montgomery and Runger 2003). Display residuals against projected values for torque and thrust force, as well as normal probability charts for associated residuals (thrust force). Thrust force and torque residuals passed medical tests.

Multiple Regression Analysis Results :

Linear regression model for thrust force :

Thrust force (N) = −17.6 + 22.4 Al_2O_3 (vol%) − 15.2 EN 36 (vol%) + 1371 Cutting feed(mm/rev) + 0.0146 Spindle speed (rpm)

CONCLUSION

To calculate thrust and torque, multiple regression analysis (MRA) and artificial neural networks were used (ANN). An excellent prediction method is to model the drilling process using MRA and ANN. Both MRA and ANN demonstrated that decreasing feed rate is followed by increasing reinforcement fractions as a factor in thrust force and torque. Spindle speeds for both types were unimportant.

Nonlinear input-output interactions are well mapped by ANN. Models like MRA and ANN generate statistically accurate predictions. ANN is quick and precise. MRA is less useful for modelling drilling than ANN.The two models are effective at simulating and forecasting drilling forces, which can be applied to manufacturing and engineering design. The modelling echniques presented in this paper can assist in anticipating, optimizing, and improving drilling operations as well as the choice of cutting parameters for materials based on aluminium and EN 36 steel alloys.

REFERENCES:

1. Da Silva, A.A.M., Arruti, E., Janeiro, G., Aldanondo, E., Alvarez, P., Echeverria, A., “Material flow and mechanical behaviour of dissimilar AA2024-T3 and AA7075-T6 aluminium alloys friction stir welds”, Materials and Design, Vol. 32, pp. 2021–2027, 2011.

2. Datta, S., Bandyaopadhyay, A. and Pal, P.K. "Application of Taguchi Philosophy for Parametric Optimization of Bead Geometry and HAZ Width in Submerged Arc Welding Using a Mixture of Fresh Flux and Fused Flux", International Journal of Advanced Manufacturing Technology, Vol. 36, pp. 689-698, 2008.
3. Elangovan, K. and Balasubramanian, V. "Influences of tool pin profile and welding speed on the formation of friction stir processing zone in AA2219 aluminium alloy", Journal of materials processing technology, Vol. 200, pp. 163-175, 2008.
4. Elangovan, K. and Balasubramanian, V. "Influences of pin profile and rotational speed of the tool on the formation of friction stir processing zone in AA2219 aluminium alloy", Materials Science Engineering A, Vol. 459, pp. 7–18, 2007.
5. Ghosh, M., Kumar, K., Kailas, S.V., Ray, A.K. "Optimization of friction stir welding parameters for dissimilar aluminum alloys", Materials and Design, Vol. 31, pp. 3033–3037, 2010.
6. Hartman, J.A., Beil, R.J. and Hahn, G.T. " Effect of copper rich region on tesile properties of VPPA weldments of 2219-T87 aluminium", Welding Journal, pp. 73-83s, 1987.
7. Jamshidi Aval, H., Serajzadeh, S., Kokabi, A.H. "Evolution of microstructures and mechanical properties in similar and dissimilar friction stir welding of AA5086 and AA6061", Materials Science and Engineering A, Vol. 528, pp. 8071– 8083, 2011.
8. Karthikeyan, R., Balasubramanian, V. "Predictions of the optimized friction stir spot welding process parameters for joining AA2024 aluminum alloy using RSM", Int J Adv Manuf Technol, Vol. 51, pp. 173–183, 2010.
9. Khodir, S. A., Shibayanagi, T. "Friction stir welding of dissimilar AA2024 and AA7075 aluminum alloys", [J]. Materials Science and Engineering B, Vol. 148, pp. 82 87, 2008.
10. Kimapong, K. Watanabe, T. "Friction stir welding of aluminium alloy to steel", Welding Journal, Vol. 83, pp. 277s-282s, 2004.
11. Koteswara Rao, S.R. "Effect of Grain Refinement, ThermoMechanical Treatments and Scandium Additions on the Mechanical Properties of AA2219 welds", PhD Thesis, 2005.