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**ISBN**

**978-983-42035-9-7**

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# Prediction of Turning Performance in Various Machining Parameter Using FEM

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**Abstract** - In recent years, the applications of finite element method (FEM) in metal cutting operations have proved to be effective in studying the cutting process and manufacturing process. The simulation result is useful for both researchers and tool makers to optimize the cutting process by designing new tools. Simulation and modelling were performed in two-dimensional and three-dimensional for designing the new component prior to fabricating. These are very useful for reducing time and cost consumption in designing automotive parts. The FEM simulation just only requires computational tool and FEM simulation package. The present work aims to predict of performance three-dimensional orthogonal of cutting operations using FEM software (Deform-3D). Some important information such as cutting force, stress, strain and generated temperature during machining process were studied and analysed. Orthogonal cutting simulations were conducted to study the effect of cutting speed, feed rate and depth of cut on the cutting force, the effective-stress, strain and generated temperature in turning process. FCD 500 (ductile cast iron) was used as the work material and cutting tool was DNMA 432 (uncoated carbide tool, SCEA = 0; BR = -5; SR = -5 and radius angle 55°). The cutting parameters varied were cutting speed (100 m/min, 150 m/min and 200 m/min), feed rate (0.1, 0.25 and 0.4 mm/rev), and depth of cut (DOC) (0.3, 0.6 and 0.9 mm). The performance was showed by the simulation results that show by increasing the cutting speed, it causes decreasing in cutting force, effective stress and strain, but the generated temperature during the chip formation process increases. High value of feed rate resulted in bigger cutting force, stress, strain and generated temperature. In addition, bigger cutting force and high generated temperature occurred at high depth of cut.

**Key Words:** *finite element method, three-dimensional of orthogonal cutting, stress and strain, generated temperature*

## I. INTRODUCTION

In the field of machine building, the term of machining means removal of material from a raw material (work piece), by cutting small chips, in order to obtain the desired shape and dimensions for final part using cutting tool. Most of automotive components

have manufactured using the machining process, like turning, drilling, shaping and planning, milling, grinding, sawing, etc. Machining is the most widespread metal shaping process in mechanical manufacturing industry. Worldwide investment in metal-machining machine tools holds steady or continues to increase year by year. In machining processes, the conditions for optimal cutting are not easy to find, because a great many experiments are first to be made for the numerous specific cutting cases. Testing is very expensive, on the other hand, tests that are made in unknown conditions are difficult and risky, and the vibrations that occur in the machine tool can cause the tool to break. For solving that problem, the modelling and simulation is the best way as replacement of that experiment.

Final Element Modelling (FEM) and Finite Element Analysis (FEA) can be run by specialized programs in finite element modelling. Some authors have used their own programs in their research, others turned to commercial programs. Currently, the world knows a large variety of specialized programs such as Abaqus, AdvantEdge, Ansys, Deform, MSc Marc, etc. In this research, the simulation will be developed especially for modeling of orthogonal cutting in turning processes by using Deform-3D. The material chosen for work piece in this work is grey cast iron that is and carbide insert is chosen as its tool cutting. The cast iron was be applied in this research. Cast iron has many advantages and a lot of application in human life, used in critical automotive components, variety of tool, tool machineries framework, building, bridge, electronic part, gymnastic tools, fence, gate, trellis, jewelleryes, etc. Beside, cast Iron is also cheap in price, and invaluable constructional material. This research aims to study the effect of cutting speed, feed rate, and depth of cut (DOC) on cutting force, stress, and temperature on turning cast iron.

## II. LITERATURE REVIEW

### 2.1. Industrial Acceptance of Machining Simulation

Simulation is an important tool for capturing the changing nature of manufacturing industry. The

competitive world economy requires that, for an industry to survive, it must minimize response times and costs, as well as maximize the efficiency and quality in producing a product. Simulation application of tool carbide in turning machining as shown in Fig.1 has large used in machining world.

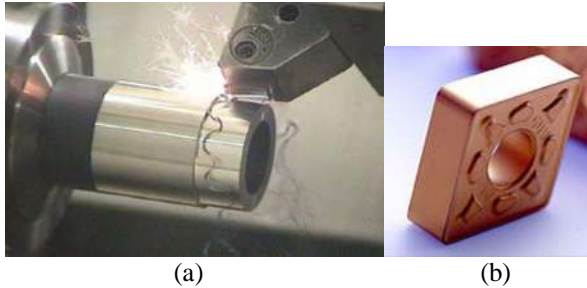


Figure 1 a). Turning process, b). Tool cutting carbide inset

Industrial acceptance of machining simulation and tool stress analysis has increased rapidly during recent years. Numerous academic examples of machining simulation have been published during the past two decades. Industrial examples have also become common place as the technology continues to spread. The growth of simulation technology in metal machining industries has come at a time when computer hardware has experienced dramatic price reduction and speed increases lasting well. Improved graphical user interfaces in commercial codes have made this technology very easy to use. The ability to analyze complex three-dimensional processes has opened up additional avenues for the application of simulation.

While Deform -3D provides sophisticated analysis capabilities, the graphical user interface is intuitive and easy to learn. Moreover, it provides utilities to manipulate 3D geometry, including Boolean capabilities to trim flash. Shearing and trimming operations can also be analyzed using the FEM engine. Even complex machining operations can be modelled. Deform-3D is the foundation for a comprehensive modelling system that integrates raw material production, forming, heat treatment and machining. Deform-3D continues the tradition of accuracy and state-of-the-art capabilities established in the early 1980's. Scientific Forming Technologies Corporation has the experience and background to provide unparalleled training and technical support [1]. Fig. 2 shows the example of simulation model, basic cutting parameters defined and mesh overview that was performed by Deform-3D.

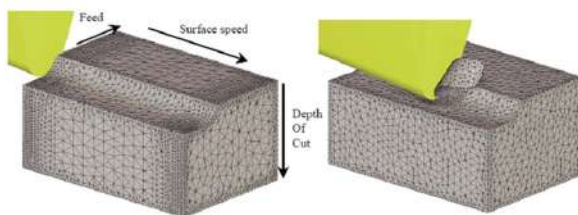


Figure 2. Simulation model and basic cutting parameters defined.

## 2.2. Finite Element Analysis with Deform-3D

Finite Element Analysis (FEA) technique was the first introduced in 1960s and still widely used for analysis such as in tools design and forming processes. Based on the success of FEM simulations for bulk forming processes, many researchers developed their own FEM codes to analyze metal cutting processes during the early 1980s up to now [2], [3], [4], [5], [6], [7], and [8]. Reference [3] assumed a rigid sharp tool and elasto-plastic workpiece, and defined a node separation criterion based on the geometry of the element approaching the cutting edge. Reference [3] used an early version of a commercial implicit FEM code "Deform-2D<sup>TM</sup>". This code uses four-node quadrilateral elements and is based on static Lagrangian formulation.

Deform-3D is a powerful process simulation system designed to analyze the three-dimensional (3D) flow of complex metal forming processes. Deform -3D is a practical and efficient tool to predict the material flow in industrial forming operations without the cost and delay of shop trials. Today, Deform-3D<sup>TM</sup> code is commonly used by researchers and industry in machining simulation. The simulation engine is capable of predicting large deformation material flow and thermal behaviour with astonishing precision [1].

Many of research on machining or chip formation have done recently years. Based on [9], the cutting force and feed force increase with increasing feed, tool edge radius, negative rake angle, and workpiece hardness. Cutting force and feed force also increased linearly while the depth of cut was increased.

The maximum temperature of chip are increasing with increasing cutting speed. This is due to the increase of required energy for increasing the cutting processes [3].

More heat will be generated as increasing of cutting speed, consequently the maximum temperature on the tool and workpiece surface increase at higher cutting speed. This is very probable to occur because the most of heat or generated temperature is carried away by the chip [10].

According to [11], the effect of cutting speed is almost negligible as compared to feed rate and depth of cut on the tool life of the carbide cutting tool. ANOVA analysis shows that the feed rate and depth of cut will greatly influence the generated cutting force which contributed about 98% to the generated cutting force.

## III METHODOLOGY

### A. Orthogonal Cutting Condition Model

One of the important parameters in the orthogonal metal cutting process is the rake angle between the face of the cutting tool and the plane perpendicular to the cutting direction. The magnitudes of tool cutting geometries have significant effects on the performance of the cutting tool and the integrity of the cut surface. The main objective of this research is to apply the finite element method to study the effect of cutting parameter like cutting speed, feed rate, depth of cut to the cutting force, stress, strain and generated temperature on

workpiece. The machining parameters were varied in cutting speeds of 100, 150 and 200 m/min, feed rate of 0.1, 0.25 and 0.4, and depth of cut of 0.3, 0.6 and 0.9. Fig. 3 shows the schematic of orthogonal cutting condition model.

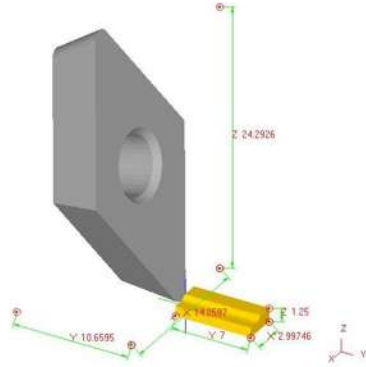


Figure. 3 Schematic of orthogonal cutting condition model

The commercial software Deform-3D for deformation analysis was used to simulate orthogonal metal cutting process. It is based on an updated Lagrangian Formulation and employs an implicit integration scheme.

### B. Parameter Inputs and Cutting Conditions

The three-dimensional finite element model was generated under a plane strain assumption because the width of cut was larger than the undeformed chip thickness in this orthogonal cutting arrangement.

Physical and thermo-mechanical properties of the workpiece and tool materials, and cutting conditions are predefined are shown in Table 1. Mathematical expression for material constitutive model in deciding flow stress data was used Oxley model [12] as shown in :

$$\sigma = \sigma_1 \varepsilon^n \quad (1)$$

Where  $\sigma$  is the material flow stress,  $\sigma_1$  the material flow stress at strain  $\varepsilon = 1, 0$  and  $n$  is the strain-hardening index.

The workpiece material was FCD 500 (ductile cast iron). This material was selected as the workpiece material in this study because it has been widely used in automotive application. The tool was modelled as a rigid body, so there were no mechanical properties need to be assigned and only thermal properties were needed. The cutting condition to the simulation models and the mechanical properties of carbide cutting tool and workpiece are shown in Table 2. The tool was defined to be a rigid body which considers thermal transfer for modelling the cutting temperature field.

Deform-3D software had been used to simulate the effect of tool cutting geometries in turning ductile cast iron using uncoated carbide cutting tool. The simulations were performed by changing the machining parameters with combinations cutting speeds of 100, 150 and 200 m/min, feed rate of 0.1, 0.25 and 0.4, and depth of cut of 0.3, 0.6 and 0.9 as given in Table 1.

TABLE. 1  
PARAMETER INPUT IN SIMULATION PROCESSES

Parameters	100	150	200
Cutting Speed, m/min	100	150	200
Feed Rate, mm/rev	0.1	0.25	0.4
Depth of cut, mm	0.3	0.6	0.9
Nose Angle	constant at 55 deg		
Rake Angle ( $\alpha$ ), deg	-5		
clearance angle ( $\beta$ ), deg	-5		

TABLE 2  
CUTTING CONDITION AND MATERIAL PROPERTIES

Tool Geometry of DNMA 432 (WC as base material, uncoated carbide tool)	
Side Cutting Edge Angle (SCEA)	-3
Back Rake Angle (deg)	-5
Side Rake Angle (deg)	-5
Nose Angle (deg)	55
Tool properties (uncoated carbide)	
Modulus Young (GPa)	650
Thermal Expansion	5e-06
Poisson Ratio	0.25
Boundary Condition	
Initial Temperature ( $^{\circ}\text{C}$ )	20
Shear friction factor	0.6
Heat transfer coefficient at the workpiece tool interface ( $\text{N/s mm}^{\circ}\text{C}$ )	45
Work piece geometry	
Thickness of workpiece (mm)	1.25
Width of workpiece (mm)	3.4
Length of workpiece (mm)	7
Workpiece properties (FCD 500; Poisson's ratio, 0.275)	
Modulus of elasticity ( $\text{kN/mm}^2$ )	169
Thermal Conductivity ( $\text{W/m. }^{\circ}\text{C}$ )	35.2
Thermal expansion Coefficient ( $\cdot 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ )	12.5
Ambient Temperature ( $^{\circ}\text{C}$ )	20
Heat capacity ( $\text{N/mm}^2 \text{ }^{\circ}\text{C}$ )	3.7
Emissivity	0.95

The simulation results of cutting force, effective-stress, strain and chip temperature on the cutting were studied and analyzed. The operation was simulated using insert carbide of DNMA 432 type that has a nose angle of 55 deg and without the use of coolant. Displacement, shape and surface mesh of the tool and workpiece at the initial mesh of beginning the cutting operation was developed until chip formation reach step 100 as illustrated in Fig. 4a , 4b, 4c and 4d respectively.

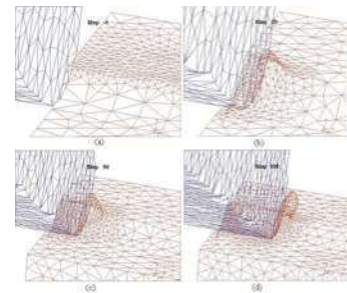


Figure 4. (a) Initial mesh and tool indentation, (b) Chip formation at step 25, (c) Chip formation at step 50, (d) Developed continues chip at step 100.

The workpiece and the tool were characterized by non uniform mesh distribution in the simulation. Very small element was required in the contact area between tool and workpiece because of very large temperature gradient and stress that will develop in this region

during the simulation. Figure. 5 shows an example of simulation result of effective stress and temperature for cutting speed of 200 m/min at 200 steps of simulation running on chip formation.

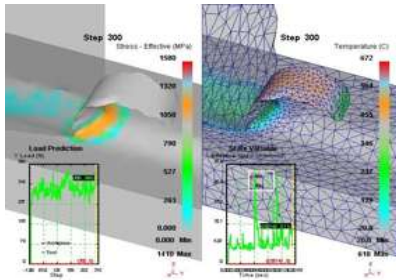


Figure 5. One example of the simulation result effective stress and temperature for cutting speed of 200 m/min (for running in 300 step)

#### IV. DISCUSSION OF RESULTS

The cutting force, effective stress, strains and chip temperature at various cutting speed, feed rate and depth of cut were studied, analyzed and discussed. The results for each simulation for varied cutting speed, feed rate and depth of cut can be seen in Table. 3.

TABLE 3  
VARIOUS CUTTING PARAMETER AS INPUT AND SIMULATION RESULTS

Cutting speed was varied; feed rate and DOC were kept constant							
No	Cutting Speed (m/min)	Feed rate (mm/rev)	Depth of cut (mm)	Cutting Force (N)	Aff. Stress (MPa)	Aff. Strain (mm/mm)	Temp (deg. C)
1	100	0.33	0.3	641	2760	13	880
2	150	0.35	0.3	567	1790	8.7	1060
3	200	0.35	0.3	506	1090	9.9	1130
Feed rate was varied; cutting speed and DOC were kept constant							
No	Cutting Speed (m/min)	Feed rate (mm/rev)	Depth of cut (mm)	Cutting Force (N)	Aff. Stress (MPa)	Aff. Strain (mm/mm)	Temp (deg. C)
1	180	0.1	0.3	174	2130	11.0	804
2	180	0.25	0.6	482	2600	12.9	1100
3	180	0.4	0.9	710	3030	15.4	1080
DOC were varied; cutting speed and Feed rate were kept constant							
No	Cutting Speed (m/min)	Feed rate (mm/rev)	Depth of cut (mm)	Cutting Force (N)	Aff. Stress (MPa)	Aff. Strain (mm/mm)	Temp (deg. C)
1	180	0.4	0.3	646	1410	7.8	1060
2	180	0.4	0.6	1110	1820	8.41	1190
3	180	0.4	0.9	1460	2260	10.9	1220

##### Effect of Cutting Speed

From Fig. 6 to 9 can be seen the result of cutting force, effective stress, effective strains and chip temperature at various cutting speeds. The cutting speeds were varied at 100, 150 and 200 m/min.

Figure 6 shows that by the increasing of the cutting speed, it will decrease the cutting force. This is agreeable with theory that by the increasing of cutting

speed will soften the material, therefore this will make material easier to cut in higher cutting speed condition.

Figure 7 shows that by increasing the cutting speed also will reduce the effective-stress. Increase of cutting speed from 100 m/min to 200 m/min will reduce the effective-stress from 2760 MPa to 1090 MPa. This is also agreeable with theory that gives formula:

$$\sigma = F/A \quad (2)$$

Where  $\sigma$  = stress, F as cutting force and A is area, stress and cutting force are positif corelation, if cutting force increase so stress also will increase.

The good result were get for the graph of temperature where the increasing of cutting speed will increase the generated temperature on chip as given in Fig. 8. This is agreeable with finding from [3] where the maximum temperature of chip are increasing with increasing cutting speed. This is due to the increase of required energy for increasing the cutting processes. More heat will be generated as increasing of cutting speed, consequently the maximum temperature on the tool and workpiece surface increase at higher cutting speed.

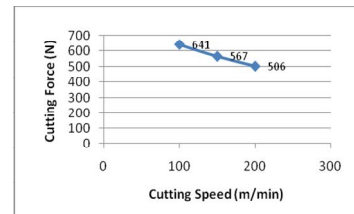


Figure 6. The graph of cutting speed vs Cutting force

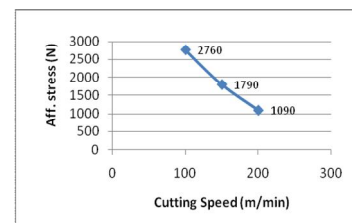


Figure 7. The graph of cutting speed vs aff. stress

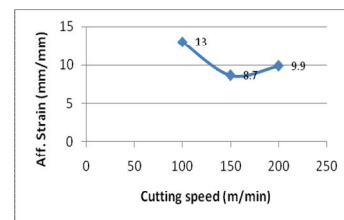


Figure 8. The graph of cutting speed vs aff. strain

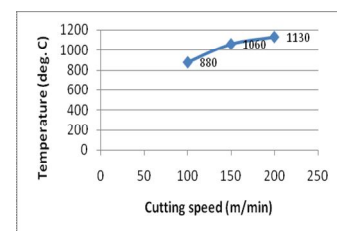


Figure 9. The graph of cutting speed vs temperature

As given in the Fig. 9, the increase of cutting speed from 100 m/min to 200 m/min lead to an increase of chip temperature from 880°C to 1130°C. This is very probable to occur because the most of heat or generated temperature is carried away by the chip. The theory also tell that during machining by cutting, it is assumed that all the cutting energy is converted to heat and, therefore, a considerable amount of heat is generated at the following three distinct zones as given Fig.10, those are 1). Shear zone (75%); 2). Chip sliding on the tool face (20%); c). Tool sliding on the workpiece machined surface (5%) which neglected for perfectly sharp cutting tools. The maximum heat is produced at shear zone because of the plastic deformation of the metal, practically all of this heat is carried away by the chip [10].

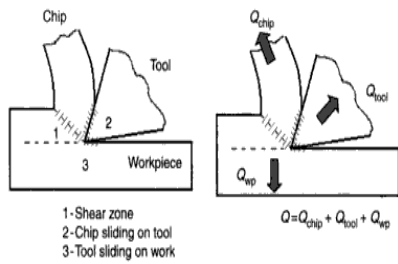


Figure 10 Heat generated and heat dissipation in metal cutting [10].

**Effect of Feed Rate**

The result of cutting force, effective stress, effective strains and chip temperature at various feed rates were plotted in Fig. of 11, 12, 13 and 14. The feed rates were varied at 0.1, 0.25 and 0.4 mm/rev.

As can be seen on from Fig.11 and Fig.14, the increase of feed rate caused the increase of the cutting force from 174 N to 710N, effective stress from 2130 MPa to 3030 MPa, effective strain from 11 mm/mm to 15.5 mm/mm, and generated temperature on workpiece from 804°C to 1080 °C

As can be seen in the Fig.11, the feed rate has the most significant effect on cutting, this is agreeable with [9]. They also said the relationship between the cutting force and feed for turning can be expressed as linier line in graph. Cutting force increases with the increase in feed due to an increase in chip load. Increase of the feed causes increase of the contact areas of chip formation, then this causes the increase of stress, and strain (Fig. 12 and 13).

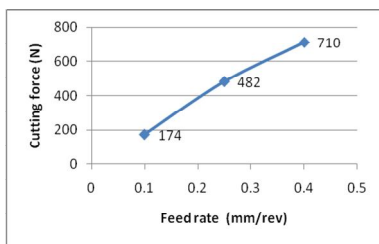


Figure 11. The graph of feed rate vs cutting Force

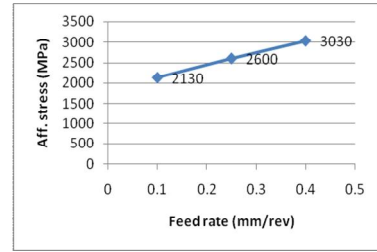


Figure 12. The graph of feed rate vs aff. stress

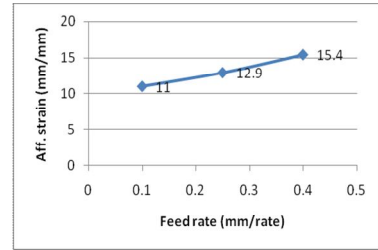


Figure 13. The graph of feed rate vs aff. strain

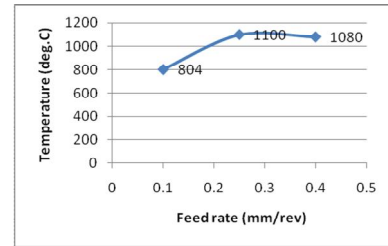


Figure 14. The graph of feed rate vs temperature

This is also agreeable with theory as given in (2), where stress and cutting force are positif correlation, if cutting force increase so stress also will increase. Generated temperature of chip also will increase due to more friction occur while the contact area are bigger (Fig.14).

**Effect of Depth of Cut**

From Fig.15 to 18 can be seen the result of cutting force, effective stress, effective strains and chip temperature at various depth of cut (DOC). The depth of cuts were varied at 0.3, 0.6 and 0.9 mm.

As can be seen on from Fig. 15 and Fig. 18, the increase of depth of cut cause the increase of the cutting force from 646 N to 1460 N, affective stress from 1410 MPa to 2260 MPa, affective strain from 7.8 mm/mm to 10.9 mm/mm, and generated temperature on workpiece from 1060 °C to 1220 °C.

Based Fig. 15, the increase of depth of cut cause the increase of the cutting force, this is agreeable with [9] where cutting force and feed force also increased linearly while the depth of cut were increased. This is also agreeable with theory where increase of the depth of cut cause bigger of chip thickness that also will cause increase of cutting load. This is also agreeable with [11] that the feed rate and depth of cut will greatly

influence the generated cutting force which contributed about 98% to the generated cutting force.

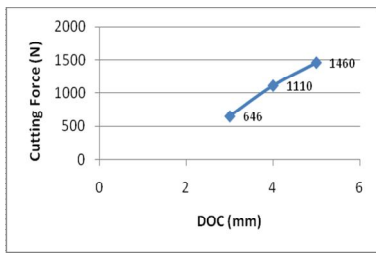


Figure 15. The graph of depth of cut vs cutting force

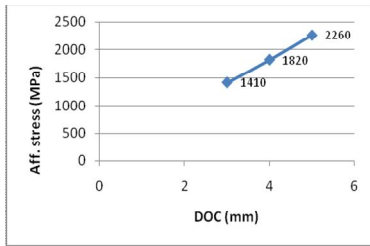


Figure 16. The graph of depth of cut vs aff. stress

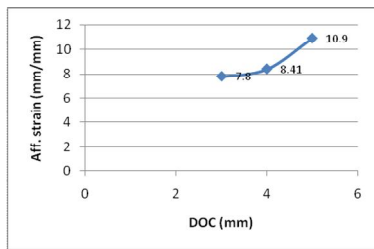


Figure 17. The graph of depth of cut vs aff. strain

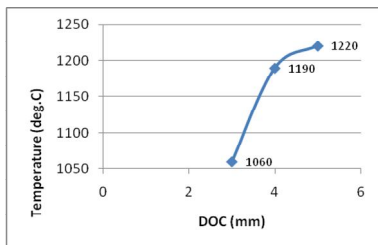


Figure 18. The graph of depth of cut vs aff. temperature

**Stress and Generated Temperature on Workpiece**

Figure 19 and 20 show the effective stress and generated temperature in workpiece with cutting speed 180 m/min, feed of 0.25 mm/rev and DOC of 0.6 mm. Figure 19 shows that the biggest deformation was occurred on the primary deformation zone, followed by the secondary deformation zone. This also caused higher stress occurred in this section which reached 2600 MPa (contour line I). This result is agreeable with [13] where the major deformation during cutting process were concentrated in two region close to the cutting tool edge, and the bigger deformation were occurred in the primary deformation zone, followed by secondary deformation zone.

Generated temperature on workpiece can be analyzed in detail based on the contour in Fig. 20. The higher temperature are for the contour line I that reach 1100°C, followed by H (967 °C), G (833 °C) and so on. Figure 15 shows the contour of stress on workpiece and chip formation. This highest temperature in the chip usually occurs in this sliding region. The highest temperature in the chip usually occurs in this sliding region, while the heat generated in the sticking region caused the workpiece material to adhere with the tool. Later it was sheared which resulted in high frictional force, consequently high is generated [13].

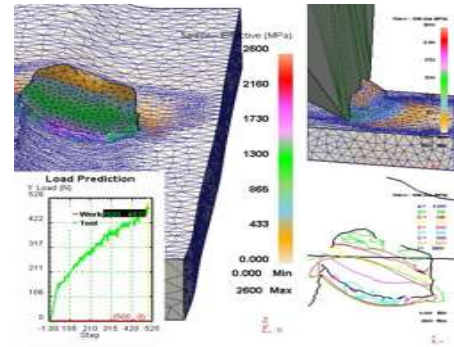


Figure 19 Effective Stress in workpiece with cutting speed 180 m/min, feed of 0.25 and depth of cut 0.6

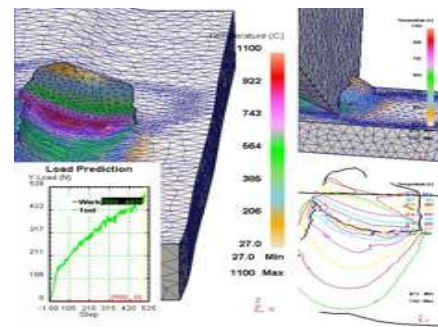


Figure 20 Generated temperature in workpiece with cutting speed 180 m/min, feed of 0.25 and depth of cut 0.6

**V. CONCLUSION**

The distribution of cutting force, effective stress and generated temperature obtained from simulations are agreeable with the result given by some of recently researcher and literature. From the simulation, it can be concluded that increasing cutting speed in the turning of ductile cast iron using tungsten carbide (CW) will decreasing the cutting force, stress, and strain, but increased generated temperature. High value of feed rate resulted in bigger cutting force, stress, strain and generated temperature. In addition, bigger cutting force and high generated temperature occurred at high depth of cut. The best performance usually in low cutting force, stress, strain and temperature and these were obtained on higher cutting speed, lower feed rate and depth of cut. For work piece and chip formation, the biggest deformation was occurred on the primary deformation zone, followed by the secondary

deformation zone. Therefore higher stress occurred in this section. The highest temperature in the chip usually occurs in this sliding region. The highest temperature in the chip usually occurs in this sliding region, while the heat generated in the sticking region caused the workpiece material to adhere with the tool. Later it was sheared which resulted in high frictional force.

### ACKNOWLEDGEMENT

The authors would like to thank to Government of Malaysia and Universiti Kebangsaan Malaysia for their financial support under 03-01-01-SF1214 and UKM-GUP-BTT-07-25-025 Grants.

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November 11, 2009

Hendri Yanda  
Jl. Aman 5 Bf2  
Kajang Utama  
43000 Kajang  
Selangor Darul Ekhsan, Malaysia

Dear Prof/Dr/Mr/Ms **Hendri Yanda**,

**Subject: Invitation to the International Conference for Technical Postgraduates 2009 at Kuala Lumpur, 14-15<sup>th</sup> December, 2009**

It is my pleasure to inform you that your paper as follows has now been accepted for presentation at the conference subject to the conference registration.

Paper ID : 305

Paper Title : *Prediction of Turning Performance in Various Machining Parameter Using FEM*

On behalf of conference organizing committee, I am pleased to invite you to participate in the International Conference for Technical Postgraduates 2009 which will be held at **Legend Hotel, Kuala Lumpur, Malaysia, 14-15 December 2009.**

The Conference aims to bring together to provide opportunities to explore recent development, current practices and future trends in all engineering disciplines, to provide a platform for engineering research discussions and networking

Conference information is made available online at <http://techpos2009.um.edu.my>. Any enquires related to the conference may please direct to the conference Secretariat at +60379674477 or by email at [techpos2009@um.edu.my](mailto:techpos2009@um.edu.my)

We look forward to seeing you at the TECHPOS 2009 in Kuala Lumpur, Malaysia.

Best Regards,

ASSOCIATE PROFESSOR DR. FATIMAH IBRAHIM  
Chairperson  
International Conference for Technical Postgraduates (TECHPOS 2009)

**Second Announcement**  
 ~Deadline of full paper submission extended to  
 15 August 2009 ~

# TECHPOS 2009

## International Conference for Technical Postgraduates 2009

14-15 Dec 2009  
 Legend Hotel, Kuala Lumpur  
 Malaysia

Towards Advancement of  
 Engineering Research – Global  
 Challenges

**Patron**

Vice Chancellor of University of Malaya

**Advisors**

Dean of Faculty Engineering  
 Deputy Dean of Research, Faculty of Engineering

**Organising Committee**

Chairperson: Assoc. Prof. Dr. Fatimah Ibrahim  
 Vice-Chairperson: Assoc. Prof Dr. Mohd Hamdi Abd  
 Shukor

Secretary: Dr. Saidur Rahman

Treasurer: Dr. Siti Zawiah Dawal

Technical coordinator: Dr Chow Chee Onn , Assoc.

Prof. Dr. Saad Mekhilef.

Logistics coordinator: Dr. Nur Hafizah Ramli@Sulong

Publicity coordinator: Dr. Adeline Chua Seak May

**Contact Details**

TECHPOS 2009 Secretariat  
 Faculty of Engineering  
 University of Malaya  
 50603, Kuala Lumpur  
 Malaysia

Tel : +603 – 7967 4486/4452/4462

Fax : +603 – 7956 1378

Email : techpos2009@um.edu.my

Website: <http://techpos2009.um.edu.my>

**Important Dates**

Submission of full paper	[15 Aug 2009]
Notification of acceptance	[15 Sep 2009]
Upload of full paper	[30 Sep 2009]
Early-bird registration	[30 Sep 2009]
Normal registration	[30 Oct 2009]

Two types of proceedings will be published via this conference:

- IEEE Techpos proceedings\* (cited in IEEEExplore and ISI),
- Techpos proceedings.

\* Papers to be published in the IEEE proceeding are subjected to IEEE technical review approval.

**Registration Fee for Techpos Proceedings**

	Local	Overseas
Early-Bird	RM 500	USD 200
Normal	RM 600	USD 250

**Registration Fee for Techpos IEEE Proceedings**

	Early-Bird	Normal Fee
IEEE member	RM 730	RM 830
Non IEEE member	RM 810	RM 910
IEEE student member	RM 600	RM 700
Non IEEE student member	RM 660	RM 760

**Organiser**  
 Faculty of Engineering



**Technical Co-sponsors**



*Yushai'ad Yusof and Nasrudin Abd. Rahim.*

4. Adaptive Network-Based Fuzzy Inference Approach of Estimating of Torque for 8:6 Switched Reluctance

*Amin parvizi, Mehdi Hassani, Amir hossien Mehbodnia, Saad Makhilef and M.R.Tamjis.*

5. Robust Maximum Torque per Ampere (MTPA) Control of Interior Permanent Magnet Synchronous Motor Drive

*S.M.Fazeli, H.W.Ping, H. Abootorabi Zarchi and J. Soltani.*

#### CS06

*Venue: Seminar Room 1*

1. Modeling the Hydraulic Performance in Water Distribution System

*Wan Fairuziana Wan Ahmad Puad, Faridah Othman*

2. Digital Elevation Model for Klang River Basin.

*Alaa Eldin M.E, Faridah Othman*

3. Comparison of Forecast Updating and Re-Forecasting of Stream flow Forecasted

*Mahdi Naseri, Faridah Othman*

4. Finite Element Analysis of Column Base Plates with Stiffeners

*Ali Karbakhsh Ravari, Ismail bin Othman*

5. Barrier-free Accessibility Model Using High Accuracy Digital Terrain Model

*Marek Mihola*

#### ME04

*Venue: Seminar Room 2*

1. Jatropha Fruit Grading by Using Image Processing

*Z. Effendi, R. Ramli and J.A.Ghani, Zahira Yaakob*

2. Software for Online Tool Wear Monitoring

*Muhammad Rizal, Jaharah A. Ghani, Mohd. Zaki Nuawi, Che Hassan Che Haron*

3. DETERMINATION OF PLANE-STRAIN FRACTURE TOUGHNESS OF AI 2014-T6 ALLOY USING A CIRCUMFERENTIALLY CRACKED ROUND BAR SPECIMEN

*Neelakantha.V.Londe, Dr. T.Jayaraju; Dr. P.R.Sadananda Rao*

4. Prediction of Turning Performance in Various Machining Parameter Using FEM

*Hendri Yanda, Jaharah A. Ghani, Che Hassan Che Harun*

5. Cost savings and emission reductions with optimum thickness of selected insulation materials and air gaps for building walls in Maldives

*Ahmed Iqbal, T.M.I.Mahlia*

#### EE07

*Venue: Seminar Room 3*

1. Simulink Representation of Induction Motor Reference Frames

*Khalaf Salloum Gaeid, Hew Wooi Ping and Haider A.F.Mohamed.*

2. Switching-table and Space Vector Modulation Direct Torque Control of Permanent Magnet Synchronous Motor Drives Simulation

*Mohamed Azmi Said, Mohd Fathi Mohd Elias, Hew Wooi Ping and Nasrudin A. Rahim*

3. A Novel Topology and PWM Single-Phase three-level Rectifier

*Krismadinata Chaniago, Jeyraj Selvaraj and N.A. Rahim.*

4. Single-Phase Five-Level PWM Rectifier

*N.A. Rahim and J.A. Jalil*

5. A Three-Phase Shunt Active Power Filter with Unified Constant Frequency Integration Control with RLC Connection Circuit

## TECHNICAL PROGRAM – TECHPOS 2009

14 December 2009 (Monday)	Grand Ballroom	Seminar Room 1	Seminar Room 2	Seminar Room 3	Seminar Room 4	Poster Area
0800 - 0930	Registration					
0930 - 1000	<p><b>Plenary Session I : "Challenges of Engineering Profession toward Globalization"</b>  <b>Dato' Paduka Engr. Hj. Keizrul Abdullah</b>                      Past President of The Institution of Engineers (IEM), Malaysia                      Venue : <b>Grand Ballroom</b>                      Session Chair: <i>Professor Dr. Masjuki Hj. Hassan</i></p>					
1000 - 1030	<p><b>Plenary Session II : "Advances in Neural Engineering"</b>  <b>Professor Metin Akay</b>                      Arizona State University                      Venue : <b>Grand Ballroom</b>                      Session Chair: <i>Professor Dr. Nasrudin Abd Rahim</i></p>					
1030 - 1045	Tea Break					
1045 - 1115	<p><b>Invited Session I : "Dynamics of Respiratory Neural Networks During Maturation"</b>  <b>Dr Yasemin Akay</b>                      Arizona State University                      Venue : <b>Seminar Room 1</b>                      Session Chair: <i>Professor Ir. Dr. Zamin Jumaat</i></p>					
1115 - 1130	Photo Session					
1130 - 1200	Opening Ceremony					

1200 - 1230	<p><b>Keynote Address : "Engineering Research in the National University of Singapore"</b>  Prof. Dr. Liew Ah Choy  National University of Singapore, Singapore  <b>Venue : Grand Ballroom</b>  <i>Session Chair: YBhg. Datuk. Dr. Ghauth Jasmon</i></p>					
1230 - 1400	Lunch					
1400 - 1430	<p><b>Invited Session II : "How to publish a highly-cited ISI journal"</b>  Associate Professor Dr. Hamdi Abd Shukor  University of Malaya, Malaysia  <b>Venue : Grand Ballroom</b>  <i>Session Chair: Professor Dr. Faisal Hj. Ali</i></p>					
1430 - 1530	CM01	CS01	ME01	EE01	AGM IEEE UM Chapter	
1530 - 1545	Tea Break					
1545 - 1700	CM02	CS02	ME02	CC01	BM01	
1700 - 1815	EE02	CS03	EE03	CC02	BM02	
<b>15 December 2009 (Tuesday)</b>	<b>Grand Ballroom</b>	<b>Seminar Room 1</b>	<b>Seminar Room 2</b>	<b>Seminar Room 3</b>	<b>Seminar Room 4</b>	<b>Poster Area</b>

0900 - 0930	<p align="center"><b>Plenary Session III : "Fractals in Nature and in Engineering"</b>  <b>Prof Dr. Marc Madou</b>  University of California Irvine  <b>Venue : Grand Ballroom</b>  <i>Session Chair : Associate Professor Dr. Fatimah Ibrahim</i></p>					
0930 - 1000	<p align="center"><b>Plenary Session IV : "Technical Communication Skills"</b>  <b>Prof. Dr. Ir. Wan Abu Bakar Wan Abas</b>  University of Malaya, Malaysia  <b>Venue : Grand Ballroom</b>  <i>Session Chair : Associate Professor Dr. Saad Mekhelif</i></p>					
1000 - 1015	Tea Break					
1015 - 1115	EE04	CS04	ME03	EE05	CS05	
1115 - 1230	EE06	CS06	ME04	EE07	CS07	PS01
1230 - 1400	Lunch					
1400 - 1515	EE08	CS08	CS09	EE09	CS10	PS02
1515 - 1530	Tea Break					
1530 - 1715	EE10	ME05	CS11	EE11	CS12	
1715 - 1730	Closing Ceremony					



**FACULTY OF ENGINEERING  
UNIVERSITY OF MALAYA**

*Certificate of Participation*

*It is hereby certified that*

**HENDRI YANDA**

*has participated in*

**INTERNATIONAL CONFERENCE FOR  
TECHNICAL POSTGRADUATES  
(TECHPOS 2009)**

*held on*

14-15 December 2009

*at the*

Legend Hotel, Kuala Lumpur  
MALAYSIA

*Assoc. Prof. Dr. Mohd Hamdi bin Abd Shukor  
Dean  
Faculty of Engineering*

*Assoc. Prof. Dr. Fatimah Ibrahim  
Chairperson  
TECHPOS 2009*