

# REVIEW PAPER ON OF SINGLE POINT CUTTING TOOL WITH TAGUCHI ROBUST APPROACH

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**ABSTRACT:-** The aim of this study is to numerically simulate the turning process in a real-time environment with FEM explicit software. Three input factors (depth of cut, cutting speed and rake angle) and two responses (stress and strain) are selected for simulation work. DOE technique (Taguchi) is used for making relationships among factors and responses. Surface response methodology is used for this study using Minitab software to identify most or less significant input factors after that apply regression modeling to develop relationships between input parameters and output results in the form of linear model equations based on regression modeling. Signal-to-noise analysis is performed to predict the effect of changing factors according to their levels to find the effect on product quality. In the basis of simulation work stress is dependent on depth of cut and rake angle.

**Key words:** Turning, Single point cutting tool, ANOVA, Taguchi, FEM, explicit dynamics

## 1. INTRODUCTION

### 1.1 Machine Tool Operations

#### Machines with Single-Point Cutting Tools

This final machining operation is required because the parts may have external and internal profiles, as well as sharp corners and flatness that cannot be accurately achieved by forming and shaping processes. Also, as a result of several engineering parts or components ought to be interchangeable, it requires control of dimensional accuracy, which can be achieved through machining process. Therefore, vital decisions got to be created throughout product style and producing coming up with regarding the extent of casting, shaping, or forming against the extent of machining to be done on a work piece.

### 1.2 About simulation, virtual manufacturing, and finite element analysis

Finite element method (FEM) theory mostly emerged during the 1950 and 60, while during the 1970s and 1980s, theories and methods were further developed and implemented in FEA software. The development of modern finite element technology can be divided into four stages, each with a duration of eight to ten years,

starting in the 1950s. The first period is characterized by the method being mainly applied to structural mechanics problems. In the second stage, the approach was expanded to address multi-problem while mathematical foundations were also given a great deal of attention, specifically on new efficient solution algorithms as well as techniques for solving large problems.

The third stage, much of the effort by researchers was directed towards the development of new elements capable of handling unbounded domains. The fourth stage characterized by new application fields, efficient algorithms for new computing systems (parallel computing) and availability of the FE software on personal computers and workstations, as well as techniques of adaptive refinement of the mesh. A number of distinctions can be made here as to what is the purpose of using FEA: Operation impact focus-The use of FEA mainly aims to improve the design of a product or a component by analyzing the effect of the loading (mechanical, thermal, or other) the structure will be subjected to during use. The result from the analysis is used to improve the design. Virtual manufacturing (VM) response focus- The use of FEA aims to investigate the response of the structure due to a manufacturing operation affecting the structural or global behavior of a car body due to spot welding (no distinction is here made as to how the welds are modeled).

### 1.3 DEFINITION

**Cutting Force:** Is a force that is generated by the cutting tool as it machines the workpiece. It may be divided into primary and secondary cutting forces.

**Primary Cutting Force:** Is a cutting force that's directly generated by the relative motion of the tool with reference to the piece of work throughout machining. It happens within the same direction as tool movement.

**Secondary Cutting Force:** Is a cutting force that's generated in response to primary cutting forces, for example, vibrations during the machining.

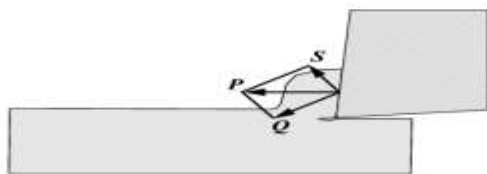
### 1.4 BACKGROUND

The business success of a replacement product is powerfully influenced by the time to market. Shorter product lead-times are of importance for industry in a

competitive market. This can be achieved only if the product development process can be realized in a relatively small time period. Usually, the material removal occurs in a highly hostile environment with high temperature and pressure, in the cutting zone. This makes the study of cutting process very complicated. The objective of metal cutting studies is to establish a predictive theory that would enable us to predict cutting performance such as chip formation, cutting force, cutting temperature, tool wear, and surface finish.

### 1.5 THE CUTTING PROCESS

Metal cutting is a process where components are arranged so that applied external force causes the figure 1.1. This fracture occurs due to the combined bending stress, the components  $S$ , and the shearing stress due to compression,  $Q$ . System consideration of the metal cutting process reveals that the competition between deformation hardening and thermal softening in the deformation zone constitutes a cyclical character of the chip formation process. As a result the parameters of the cutting system vary over each chip formation cycle.



**Figure 1.3** The interaction between tool rake face and the chip. The penetration force  $p$  acts on the chip, causing the compressive force  $Q$  and bending force  $S$ .

### 2. LITERATURE REVIEW

The purpose of this chapter is to produce a review of past analysis efforts associated with orthogonal cutting, turning, single-point cutting implement and finite part analysis. A review of alternative analysis studies is additionally provided. Substantial literature has been studied on model geometry, material model and properties, and finite element analysis of single-point cutting tool. There is square measure data are often found on technique to develop numerical model conjointly. The review is done to offer insight to how past research efforts have laid the groundwork for subsequent studies, including the present research effort. The review is careful so the current endeavor is often properly tailored to feature to the current body of literature still on justly the scope and direction of the present research effort.

**Stephenson [1]** researcher recommended that the temperature distribution within the tool may well be obtained by using data concerning the changes within the hardness and microstructure of the steel tool. It is calibrate the hardness of the tool with respect to the

temperature and time of heating and samples of structural changes at corresponding temperatures. These ways allow activity of temperatures to an accuracy of  $\pm 25$   $^{\circ}\text{C}$  at intervals the heat affected region.

**Miller et al [2]** Researcher use other technique of Experimental techniques using trendy, digital infrared imaging and successfully applied them during this study to gather cutting tool temperature distributions from orthogonal machining operations.

**ABHANG L.B [3]** worked to live the tool-chip interface temperature through an experiment throughout turning of EN-31 steel alloy with wolfram inorganic compound inserts employing a tool-work thermometer technique. First and second order mathematical models square measure developed in terms of machining parameters by using the response surface methodology on the idea of the experimental results. The results are analyzed statistically and graphically. The metal cutting parameters thought-about square measure cutting speed, feed rate, depth of cut and power nose radius.

**S.K. Chaudhary et al. [4]** Researcher Predicted cutting elongating temperatures by natural tool work thermocouple technique, when machining EN 24 steel work piece and HSS with 10% cobalt as the cutting tool. The results indicated that a rise in cutting speed and feed rate resulted in a rise in tool wear and cutting zone temperature will increase with the rise within the cutting speed. While within the whole vary of feed the temperature will increase with increase in feed rate.

**Federicom Aneriro et al. [5]** Investigated the influence of cutting parameters (cutting speed, feed rate and depth of cut) on tool temperature, tool wear, cutting forces and surface roughness when machining hardened steel with multilayer coated carbide tools. A standard K-type of thermocouple junction inserted close to the rake face of the tool was accustomed live the interface temperatures. They ended that the temperature close to the rake face will increase considerably once the depth of cut changes from zero.2 to 0.4 mm. The increase in grips length between chip and rake face can be accountable, since it grows, together with uncut chip cross-section. Similar trend was ascertained within the cutting forces, tool wear and surface roughness during machining of hardened steel.

**H. Ay and Yang [6]** seven used a way with K thermocouple junction to investigate temperature variations in inorganic compound inserts in cutting numerous materials like copper, cast iron aluminum 6061 and AISI 1045 steel. They ascertained oscillations in temperature close to the leading edge, which were more marked for ductile materials and less in the hard – machining materials. Through observations were

attributed to the chip formation and its contact with the work material.

**Kashiway and Elbestawi [7]** investigated the effect of cutting temperature on the integrity of machined surface. It has been shown that cutting temperature incorporates a major impact on the integrity on the machined surface. The undesirable surface tensile residual stresses were attributed to the temperature generated during machining. Therefore, dominant the generated tensile residual stresses depends on the understanding of the impact of various method parameters on the cutting temperature.

### References

- [1]D.A. Stephenson, Tool -work thermocouple temperature measurements: theory and implementation issues, Proceedings of winter Annual meeting of ASME, Anaheim CA. pp-18-95. November (1992).
- [2]Miller Mark R., Mulholland George, Anderson Charles, Journal of Manufacturing Science and Engineering, vol. 125(2003), pp. 667-673
- [3].L.B.ABHANG and M.HAMEEDULLAH Department of Mechanical Engineering, Aligarh Muslim University, Aligarh, India "Chip-Tool Interface Temperature Prediction Model for Turning Process" 2010.
- [4].S.K Choudhary, G.Bartarya, Role of temperature and surface finish in predicting tool wear using neural network and design of experiments.Int. J.of machine tools and manufacture,43, (2003), 747-753.
- [5]. Federico M. Aheiro Reginalot, Coelho, Lincdnc, Brandao, Turning hardened steel using coated carbide at high cutting speeds. J.of the Braz.soc.of Mech.sci.and Engg.(2008), vol no.2 1109
- [6]. H.Ay, W.J Yang, Heat transfer and life of metal cutting tools in turning, Int, J. Heat and mass transfer,41,(1998),613-623.
- [7]. Kishawy, H.A. Elbestawi, M.A, Effect of edge preparation and cutting speed on surface integrity of die materials in hard machining, ASME Int.Eng. Congr, Exp. Manf.sci, Techno, (1998), 269-276.