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Generating Point Cloud Data by Using CMM for Surface Modeling and Select Proper Cutting Method to Optimize Total Machining Time

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ABSTRACT

CNC technology is developed rapidly and each year they have advancing progress. Analysis of programming and simulations of manufacturing process in CNC milling machine applying through Mastercam software(CAD/CAM) which realizing different kind of cutting method of material. CAD/CAM system have same efficiency and functions based on algorithms of reliable theory, but don't have own unique feature for machining speed and productivity. In other command, Mastercam software(CAD/CAM) system consider only the characteristic of workpiece material to be produced, which they generate almost same NC program if we produced are the same, even though can be use different cutting method for material and also analysis of total machining time.
Keywords : CMM machine data, CAD Software and Master-Cam Software.

I. INTRODUCTION

A coordinate measuring machine is device for measuring the physical geometrical characteristics of the object. This machine may be manually operated by a skill operator or may be computer controlled. Measurements are defined by probe attached to the third moving axis of this machine. Probes like as; mechanical, optical, laser, or white light, among others. A machine which measuring readings in six degrees of freedom and display these readings in mathematical form is known as CMM. While preparing a program for machining certain components, it is necessary to specify the path for tool movement. Therefore, a geometric data of a component is converted into machine language called CNC program.

II. METHODS AND MATERIAL

Different Cutting Methods

In Master-CAM software machine profile, there are different types of machine available. Like as

1. Mill
2. Lathe
3. Wire
4. Router

In milling machine our main objective of this project is to get a cutting time optimization in CNC end milling machine. First we observe with Master CAM software by optimization of tool path using CAD/CAM simulation. Second we required to selection of different types of cutting methods and choose cutting methods to minimization total machining time.

Pocket milling is the removal of material inside closed boundary on flat surface of a work-piece there are different types of cutting methods (i.e. tool path) for roughing operation as shown in Fig. 1.

1. Zigzag
2. Constant over spiral
3. Parallel spiral
4. Parallel spiral clean corners
5. High speed
6. True spiral
7. One way
8. Morph spiral

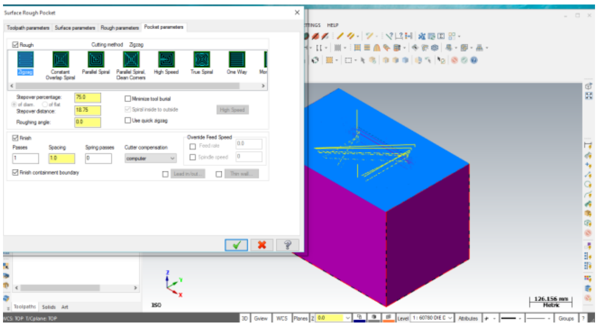

Figure 1. Cutting methods for pocket milling

Similarly, for contour milling is the removal of material peripheral surface of a work-piece there are also available different types of cutting methods (i.e. tool path) for roughing operation as shown in Fig. 2

1. High speed
2. Broken
3. Ramp
4. Follow surface

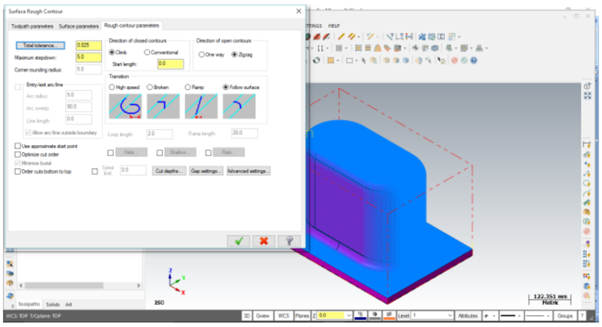

Figure 2. Cutting methods for contour milling

The use of CNC machines in manufacturing industry has led to the development and wide application of computer aided design and manufacturing (CAD/CAM) software. This software has the capability to generate important machining procedures and parameters which include tool paths. Pocket milling which involve the removal of all material inside a closed boundary makes use of CAM generated tool paths to remove material to a fixed depth. The efficiency of these CAM generated tool paths in carrying out various pocket milling operations has become an important subject of research, since more than 80% of all mechanical parts which are manufactured by milling machines can be cut by NC pocket milling[9].

C. X. (Jack) Feng (2000) have elaborated a computer-aided reverse engineering (CARE) approach. In this approach, a coordinate measuring machine is used to digitize an existing mechanical object, and then a piece of software called ScanPak is used to generate the IGES file of the point data from coordinate measuring machine digitization. Pro/Engineer then is use to create the solid model of the object, and finally the bounded object manufacturing process (LOM - one of the many rapid prototyping technologies) is use to duplicate the object. The methodology is presented, and a case study has been illustrating the approach [2].

V.H. Chan et.al (2001), finds that two primary aspects of reverse engineering are accomplished by the incorporation of a digital camera into the CMM system: tool path planning for the touch probe and the identification of separate surfaces on the object. Although uses of neural networks for machine vision are absolutely established, the use segmenting of images with non-coercive boundaries for application in RE has proved promising. [3]

M. Sokovicet. al (2006) elaborated that how some product development processes Reverse Engineering allows to generate surface models by three dimensional(3D) scanning technique, and consequently this methodology permits to manufacture different parts (for cars, for household equipment and tools (dies, press tools) in a short development period.[5]

S. Babuet. al (2011), studied about pattern less casting process using CAD\CAM applications, scanning/digitizing, coordinate measuring arm machine, and five-axis machine. An adjustable diffuser vane blade used in oil and gas industry was manufactured by RE and pattern less process starting from a worn out sample. The obtained point cloud data is imported to CAD\CAM software to develop the 3D model. Then direct sand blocks (cope and drag) milling on Poseidon CNC specific purpose five-axis machine was adopted completely eliminating any use of patterns. The moulds were directly used for metal pouring at the casting stage. [6]

CNC technology is developed rapidly and each year they had advancing progress. Analyze programming and simulation of manufacturing process in milling machine with CNC MIKRON are applying through software Mastercam(CAD/CAM) which enables realizing different kind of conture.CAD/CAM systems have similar efficiency and functions based on common algorithms of reliable theories, they don't have their unique features for machining speed and efficiency. In other command Mastercam system consider only characteristics of workpiece to be produced, which means that they generate almost the same NC data if the workpiece produced are same, even though can be used different machines for the realizing workpiece.[8]

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A comparison of milling cutting path strategies for thin-walled aluminum alloys fabrication. To search for more efficient cutting path strategies for thin-walled parts, an interactive process planning and analyzing method is introduced. Several rigid combinations of machining parameters are examined based on the evaluation of surface finish, thickness accuracy and machining time in the visual charts. In order to obtain the best cutting path strategy, Master-Cam X MR2 software have been used to utilize the cutting path for machining thin-walled aluminum alloy parts into CNC end milling machine. The resulting of cutting path strategies is solved by experimental method. From the experiment, it was found that true spiral is the best machining strategy in term of thickness accuracy but lack of surface roughness when compared to other machining strategies. Not only the best surface roughness was observed for parallel spiral strategy but also the machining time was significantly better [10].

OBJECTIVE OF THE RESEARCH

Study of literature indicates that apply RE tools for generate point data cloud with help of CMM and prepare CAD data for designing different components and prepare tool path with help of CAM software which gives optimum tool path for better surface finish with minimum time.

So, this research paper suggested that prepare point cloud data for surface modelling of die and punch and use this data for generate tool path for CNC machine with selecting proper cutting methods to optimize total machining time.

DESIGN OF DIE AND PUNCH BY RE

First of all generate point cloud data with help of CMM machine and convert CMM data to CAD data to generate surface model with help of CAD. CMM point cloud data as shown in Fig.3.

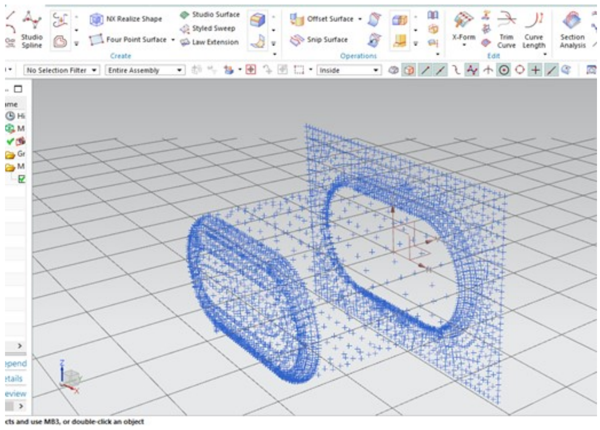

Figure 3. CMM point cloud data

Import this data in NX software and convert into .dwg file for AutoCAD and covert point cloud data into surface model as shown in Fig 4 and 5.

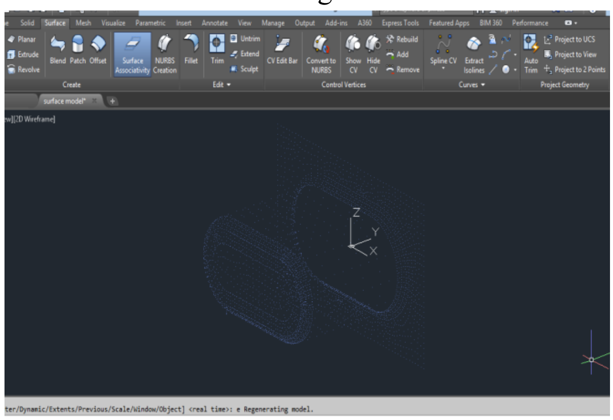

Figure 4. Imported CMM point cloud data in CAD package

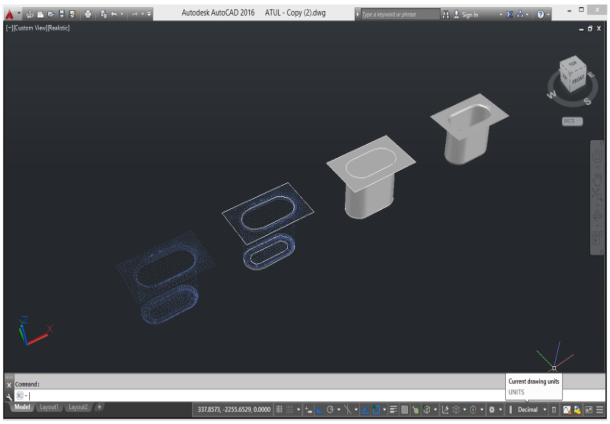

Figure 5. Surface Model in AutoCAD

Now use this surface model for design die and punch for machining using more powerful CAD software.
In which import this surface model in CAD software and use surface treatment tool replace face and select the face of surface and solid object and finally generate die model from surface model. Similarly prepare model of punch by reverting selection as shown in Fig. 6 and 7 for die and Fig. 8 and 9 for punch.

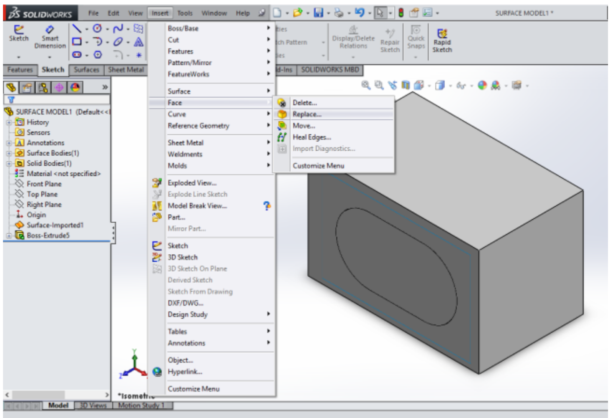

Figure 6. Solid Modelling of die

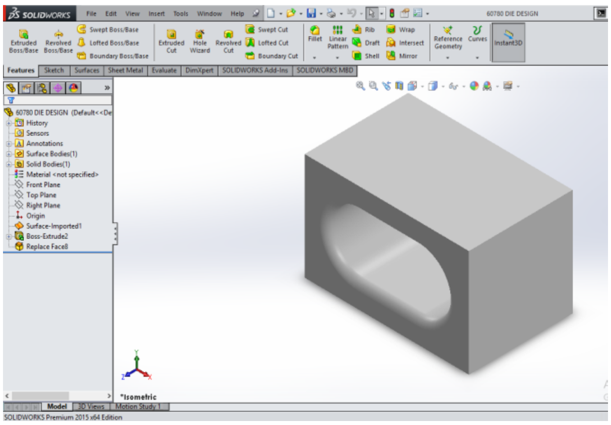

Figure 7. Final Model of die

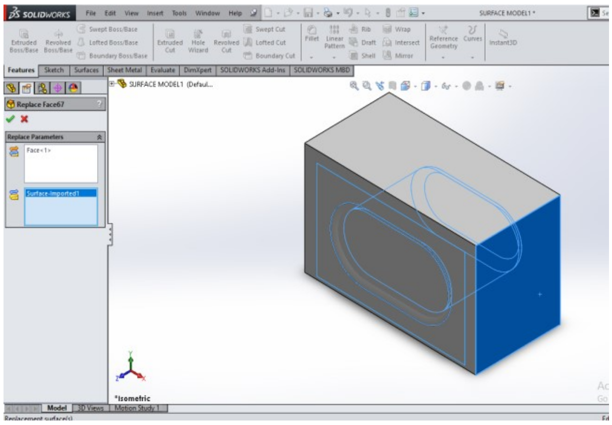

Figure 8. Solid Modelling of Punch

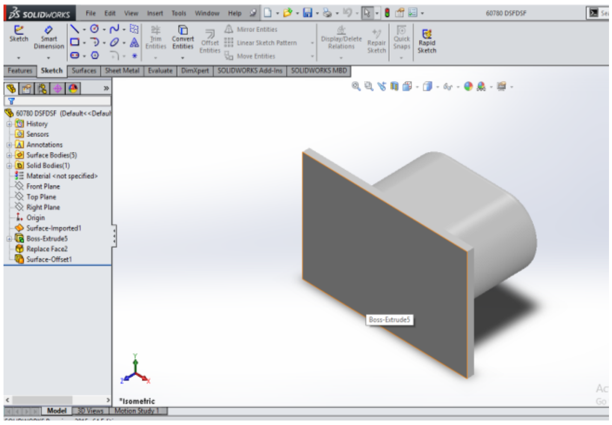

Figure 9. Final Model of Die

TOOL PATH GENERATION FOR DIE

First of all import die.iges file in Master-cam software and choose mill machine type machining.

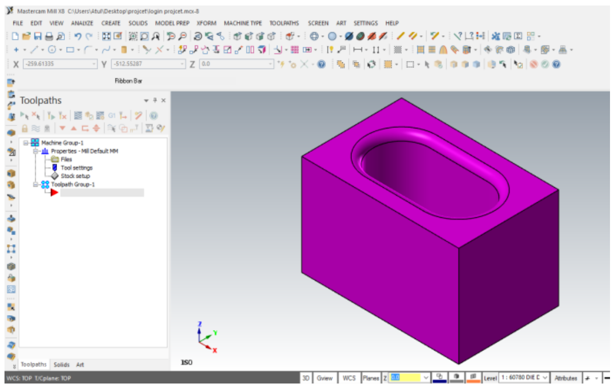

Figure 10. Imported die model in Master CAM

Set all required tool i.e. bull endmill (25 mm Diameter) and cutting parameters which is suitable for this component as shown in Fig. 11

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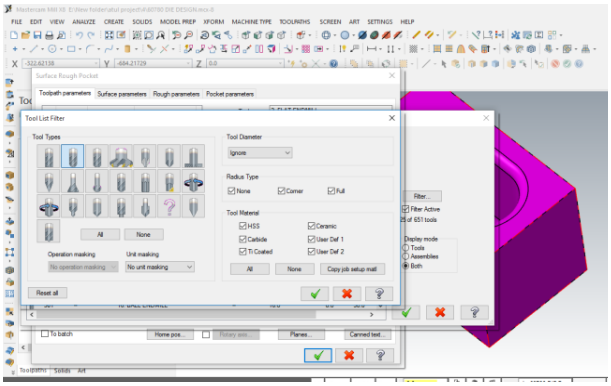

Figure 11. Selection of Cutting Tool for Die

Selection of cutting tool for pocket milling to remove material inside closed boundary of a work piece.

After roughing operation we make surface finishing of the die.

Different methods of surface finishing are available. Choose appropriate for die.

1. Zigzag
2. Constant overlap Spiral
3. Parallel Spiral
4. Parallel spiral clean corners
5. High speed
6. True spiral
7. One way
8. Morph Spiral

Analyzing machining in Master-CAM simulator and observe different cutting method overall time as shown in Fig. 12.

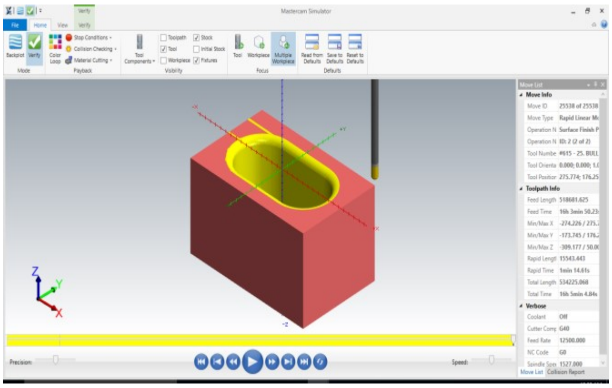

Figure 12. Machining of Die

TOOL PATH GENERATION FOR PUNCH

Similarly import punch.iges file in Master-cam software and choose mill machine type machining

Set all required tool i.e. bull endmill (25 mm Diameter) and cutting parameters which is suitable for this component as shown in Fig. 13

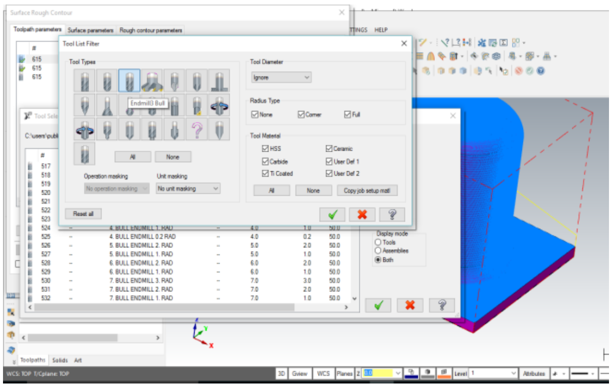

Figure 13. Selection of Cutting Tool for Punch

Many cutting methods are available choose among different cutting method for roughing and finishing process and check the total machining time s shown in Fig.14 & 15.

Available cutting methods are as following

1. High speed
2. Broken
3. Ramp
4. Follow surface.

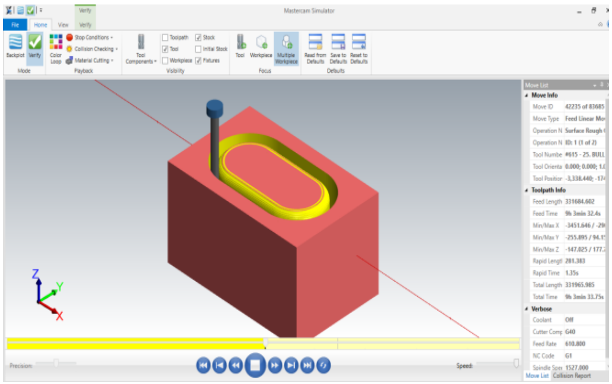

Figure 14. Machining of Punch

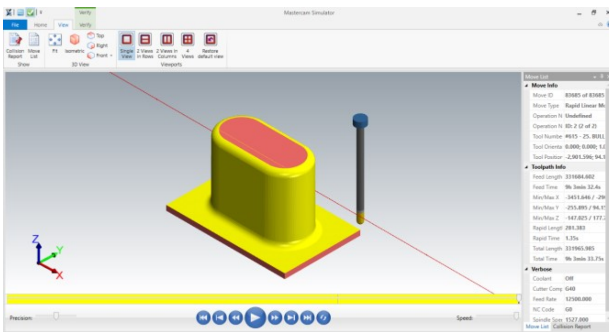

Figure 15. Finished Component

III. RESULTS AND DISCUSSION

1. Machining Time of Die

Table 1 showing roughing time and finishing time elapsed during machining of die.

Cutting method	Surface Rough pocketing time	Surface Finishing Time	Total time
Zigzag	7h 41min 8.11s	6h 35min 34.13s	14h 16min 47.47s
Constant overlap Spiral	8h 13min 18.78s	6h 35min 34.13s	14h 48min 57.6s
Parallel Spiral	8h 28.35s	6h 35min 34.13s	14h 36min 7.18s
Parallel spiral clean corners	8h 28.21s	6h 35min 34.13s	14h 36min 7.44s
High speed	7h 50min 48.42s	6h 35min 34.13s	14h 26min 26.96s
True spiral	10h 52min 12.82s	6h 35min 34.13s	17h 27min 53.12s
One way	8h 28min 53.23s	6h 35min 34.13s	15h 4min 34.59s
Morph Spiral	11h 24min 45.68s	6h 35min 34.13s	18h 25.04s

Table 1. Machining time of Die

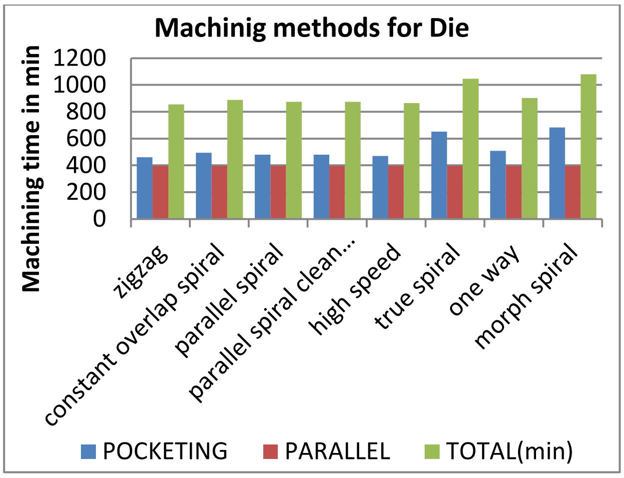

Figure 16. Comparison of different machining methods for Die

2. Machining Time of Die

Table 2 showing roughing time and finishing time elapsed during machining of punch.

Cutting method	Surface rough contour	Surface finishing	Total time
High speed	1h 52min 11.13s	7h 12min 38.56sec	9h 4min 50.85sec
Broken	1h 50min 54.58sec	7h 12min 38.56sec	9h 3min 33.75sec
Ramp	1h 52min .21sec	7h 12min 38.56sec	9h 4min 39.93sec
Follow surface	1h 50min 23.94sec	7h 12min 38.56sec	9h 3min 3.1sec

Table 2. Machining time of Die

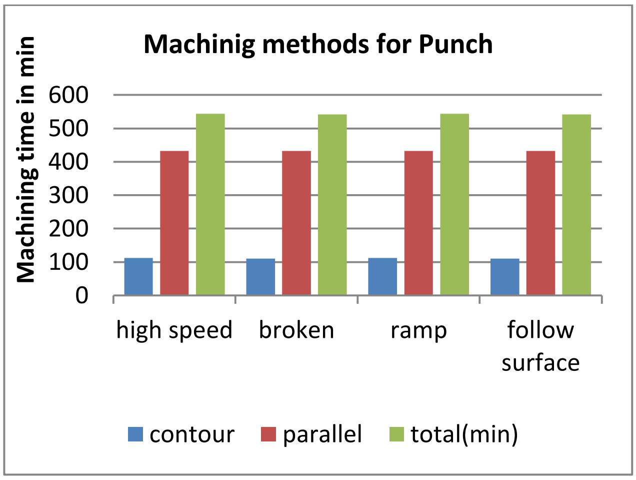

Figure 17. Comparison of different machining methods for punch

IV. CONCLUSION

From the analysis, Zigzag machining method gives minimum machining time. due to shortest distance covered by tool during machining it is 14 hours 16 minutes 47 seconds (856 minutes) for die as shown in Fig. 16 and there is no significance difference in machining time for punch but follow surface method gives minimum machining time it is 9 hours 3 minutes 3 seconds (542 minutes) as shown in Fig.17.

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