INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Design and Simulation of Die Casting Mould using Robot Paths

K. Venkata Narayana Raju
Research Scholar, JNTUA College of Engineering Pulivendula,
Pulivendula, Kadapa, Andhra Pradesh, India
B. Yeswanth Kumar Reddy
Adhoc Professor, JNTUA College of Engineering Pulivendula,
Pulivendula, Kadapa, Andhra Pradesh, India

Abstract:
For an injection moulding die casting moulds cavity and core plate is designed and simulated using different tool paths. The aim is to find out the better surface finish tool path using robot simulation results in reducing human errors and uniform surface finish. In this paper modeling and machining is done by Unigraphics NX 9.0 and generated a CNC tool paths. This CNC tool path is converted to Robot path and imported to KUKA robot. A felt polishing bobs tool is fixed to the end effectors 10mm Dia and 100mm length. Through simulation the robot polishing is done.

Keywords: *Die casting moulds, UNIGRAPHICS NX, Design, CNC tool path, KUKA robot.*

1. Introduction

One of the most common manufacturing methods of converting plastics from the raw material to an article is to use by the process of injection molding. This process is most typically used for thermo plastic materials. The main objective of the injection molding is to fill a mold with hot molten plastic and then cool the plastic to solidify to the desired shape of the parts being produced. Injection molded components are a feature of almost every functional manufactured article in the modern world, from automotive products through to food packing. This versatile process allows us to produce high quality, simple or complex components on a fully automated basis at high speed with raw materials that have changed the face of manufacturing technology over the last 50 years or so.

Injection molding equipment mainly comprises of Injection molding machine and mold. Aluminum cost substantially less than steel, so aluminum is economical for molding hundreds and thousands of parts. Aluminum molds also offer quick turnaround and faster cycles because of better heat dissipation.

.

2. Process Chart

The following flowchart shows

- Automatic evolution model for polishing
- Selection of optimal tool path
- Selection of polishing parameters
- Simulation of polishing process of the die casting mould

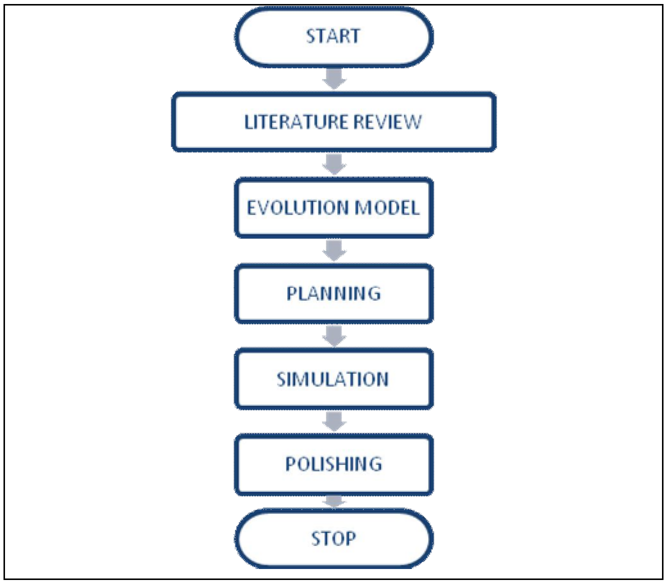


Figure 1

3. Modeling and Machining of Die Casting Mould Component

The modeling and machining of cavity and core plate moulds was built by using UNIGRAPHICS NX software, generated a CNC tool path.

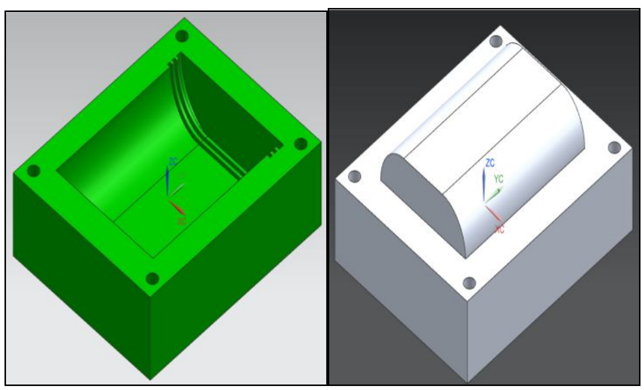


Figure 2: cavity plate and core plate

3.1. Manufacturing

This being the essence of CAD/CAM integration, the most widely and commonly used technique is to generate program codes for CNC machines to mill the part. This technological development reduces the amount of human intervention in creating CNC codes. This also facilitates the designers to create complex systems. In this paper, we will cover the Manufacturing Module of NX 9.0 to generate CNC codes for 3-Axis Vertical Machining Centers. The manufacturing module allows you to generate the tool path and machining of the part.

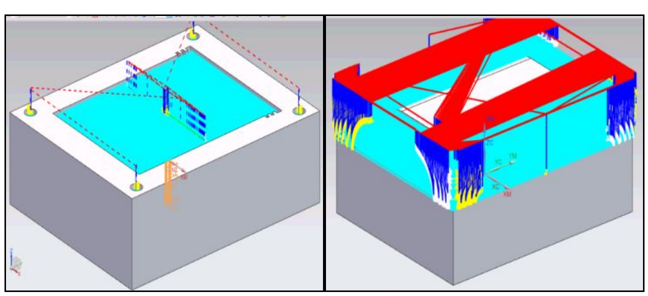


Figure 3: Generation of tool path for both cavity and core plate

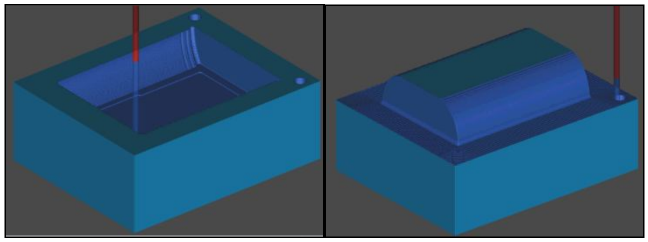


Figure 4: Machining of die moulds in unigraphics

After the selection of tool path and the polishing parameters, the tool path is generated in NX- Unigraphics software. The CLS file, thus obtained is as shown in the figure 5

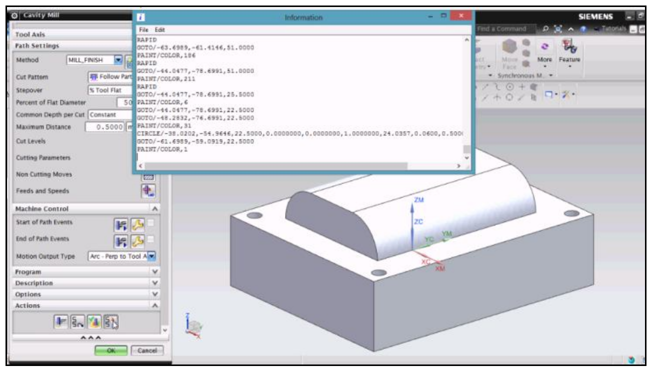


Figure 5: shows generation of CLS part program.

3.2. Overview of Robotic Polishing Process

Surface finishing can be expensive, time consuming, labour intensive, and error prone. For industries like the mold and die industry, surface finishing for a mold cavity involves many stages of processing. Mistakes committed by a human operator at a later stage may result in expensive re-working or even scrapping of the mold. In order to increase cost efficiency and to reduce exposure to human errors, it is very desirable to automate surface polishing by machines.

Polishing also does not require as high a positioning accuracy, or else it could not have been performed by human operators. Thus, articulated robots, which are dexterous and capable of positioning and orienting end-effectors' tooling according to the shape and contour of part surfaces, are potentially more suitable for surface polishing automation than machine tools. An example of an articulated robot is shown in the figure.

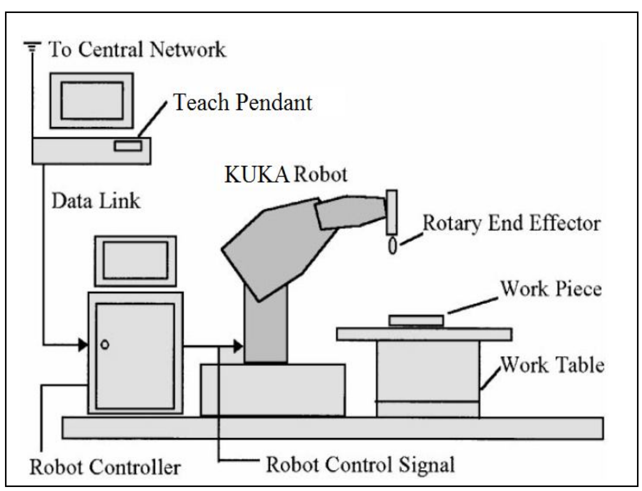


Figure 6: Schematic Diagram of Robotic Polishing Process

<u>3.2.1. Experimental Setup</u>

An important part of robotic surface polishing is tool-path generation

- Spiral tool path
- Trochoidal tool path
- Square type tool path

3.2.2. Approximation to a Sample

As Experimental trials on the die mould directly are not economical, a sample workpiece is designed in Unigraphics-NX and Machined in the 3-Axes Machining centre. The sample workpiece are convex and concave hemispherical solid bodies with 60mm radius of curvature as shown below

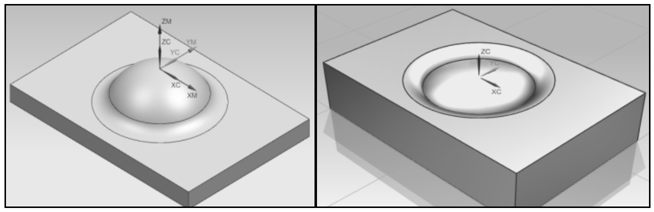


Figure 7: Cad models of samples A. Convex B.Concave

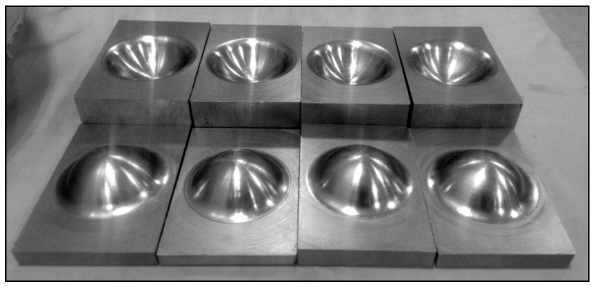


Figure 8: Machined samples

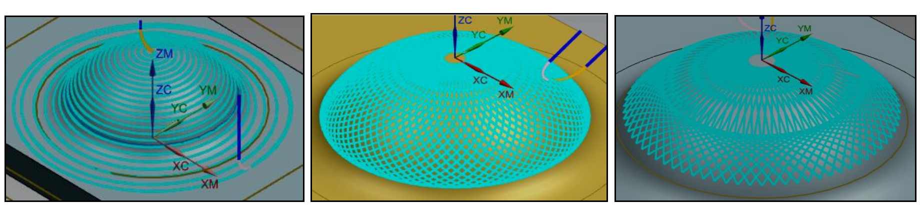
For polishing of the samples, CLS (x,y,z,i,j,k) file generated in Unigraphics-NX is converted into .src and .dat (x,y,z,A,B,C) files which can be directly fed to the robot postprocessor. Where i,j,k are the directional cosines and A,B,C are the orientation about z,y,x respectively.

3.2.3. Experimental Trials

With an intention to select the optimal tool path patterns for the polishing of the die mould a series of experiments are carried out on the samples with different tool path patterns.

Experiment 1: Sample Convex

- Tool path: Spiral, Trochoidal, Square type
- Feed: 0.3 m/s
- Deformation of tool: 1mm
- Rotation speed: 12,000 rpm
- Number of passes: single and multi passes



Spiral type Trochoidal type Square Type tool patterns

Figure 9

S. No	Tool Path	No of passes	Surface Roughness (R_a)
1	Spiral	1	0.212
2		2	0.092
3	Trochoidal	1	0.142
4		2	0.077
5	Square type	1	0.116
6		2	0.056

Table 1: Surface roughness values measured on convex samples

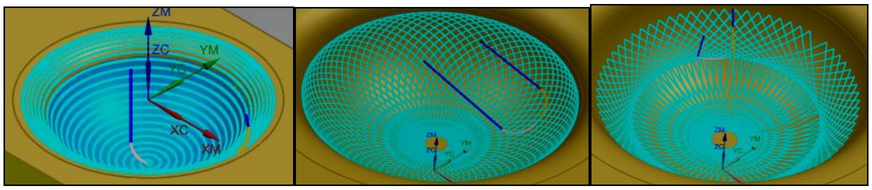


Figure 10: Experiment 2: Sample Concave

S. No	Tool Path	No of passes	Surface Roughness (R_a)
1	Spiral	1	0.243
2		2	0.0895
3	Trochoidal	1	0.142
4		2	0.0720
5	Square type	1	0.127
6		2	0.069

Table 2: Surface roughness values measured on concave samples

3.2.4. Results of Experimental Trials for the Selection of Tool Path

Figures below are the results from the experimental trials conducted for the selection of tool path.

S. No	Tool Path	No of passes	Surface Roughness (R_a)
1	Spiral	1	0.227
2		2	0.0795
3	Trochoidal	1	0.142
4		2	0.0745
5	Square type	1	0.121
6		2	0.0625

Table 3: Average surface roughness values for each tool path

Surface roughness values under different conditions are presented in table 1-3. It can be observed that with the increase in number of passes, surface roughness is reduced. For square type tool path, surface roughness obtained is the least.

Graphical comparison of Surface Roughness obtained:

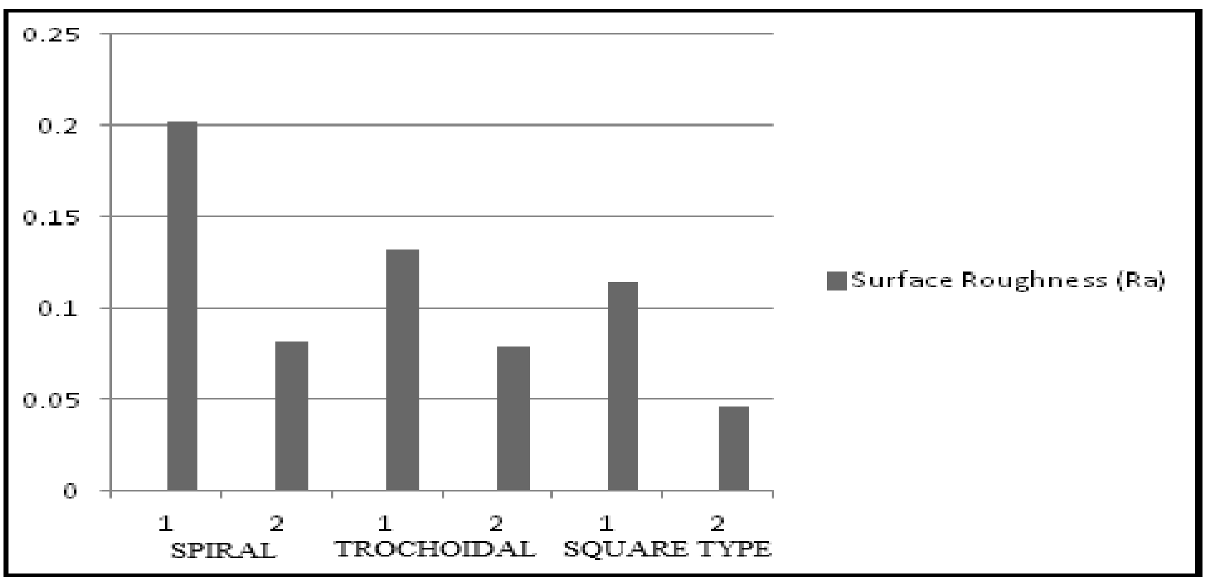


Figure 8: Comparison of Surface Roughness Values Measured On Convex Samples

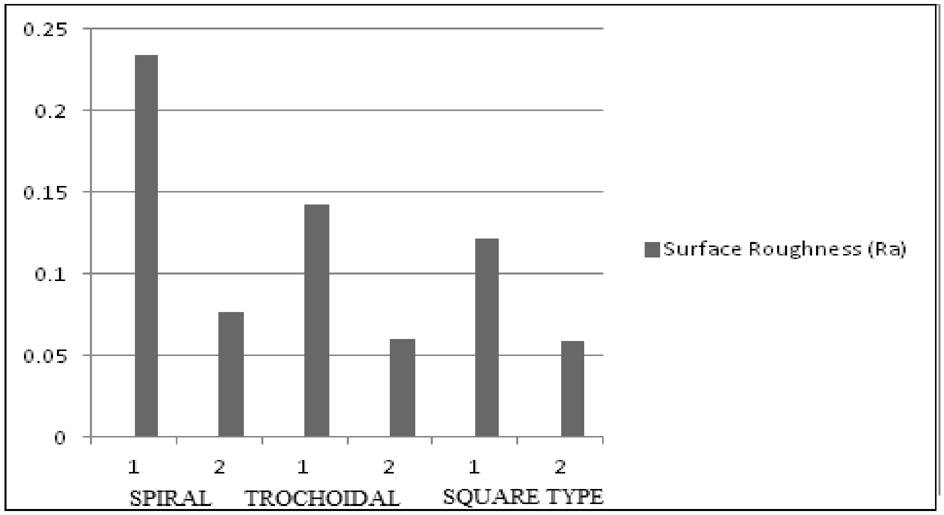


Figure 9: Comparison of Surface Roughness Values Measured On Concave Samples.

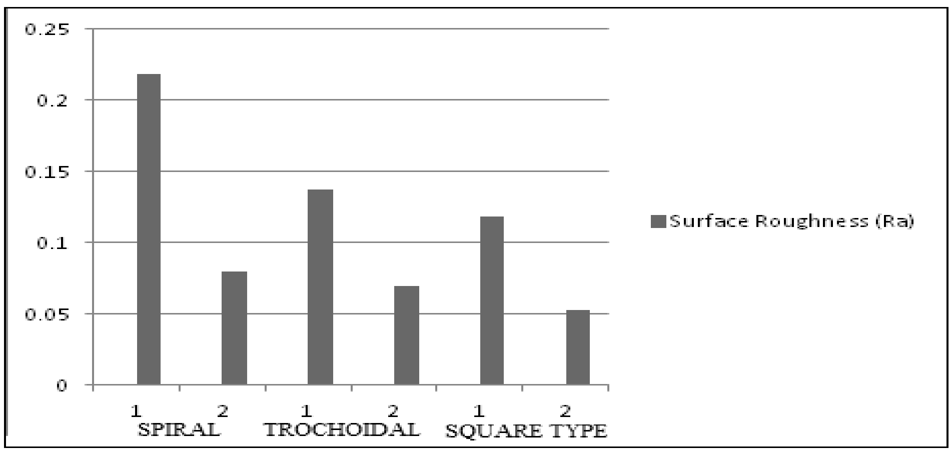


Figure 10: Comparison of Average Surface Roughness Values of Each Tool Path Pattern

As we can notice from the comparison graphs, the surface roughness value measured is least when the square type tool path is used for polishing the samples, the tool path pattern considered for polishing the die cavity and core moulds is the same.

4. Conclusion

By reviewing this paper it shows clearly that the substitution of traditional manual processes can be done with advantages in time and costs, with usual economical schemes in technological environments and with surface roughness better than the manual processes the surface roughness obtained with the square type pattern is lower in comparison to the surfaces polished with the spiral and trochoidal patterns.

5. References

i. Y. Mizugaki, M. Sakamoto, K. Kamijo, N. Taniguchi, Development of a metal-mold polishing robot system with contact pressure control using CAD/CAM data, Ann. CIRP 39 (1990) 523-526.
ii. B. Nowicki, M. Szafarczyk, The new method of free-form surface honing, Ann. CIRP 42 (1993) 425-428.
iii. P.S. Mahadev, A. Bagchi, F.W. Paul, C. Zhu, Brush finishing and polishing a technology review, Manuf. Rev. 4 (4) (1991).
iv. R.J. Stango, R.A. Fournelle, S. Chada, Morphology of surfaces generated by circular wire brushes, J. Eng. Ind. 117 (1995) 9-15