

A REVIEW ON BURR FORMATION STUDY USING MACHINE LEARNING IN END MICRO MILLING PMMA (POLYMETHYL METHACRYLATE) AND PC(POLYCARBONATE) SUBSTRATES

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Abstract: Micro milling is a machining method which is used for the production of micro components and used in the micro fluids form like poly methyl methacrylate (PMMA) or Polycarbonate (PC) i.e. Plastic. Advantage of using micro milling is fabrication process is faster , it is low cost ,and it is used to fabricate the structures that are more complicated. In this study PMMA has taken as substrate for micro milling which is followed by factor analysis. The parameters are spindle speed, depth of cut and Surface quality. Surface quality is measured by the instrument called stylus profilometer. In this paper includes 450 experiments of the micro milling by different parameters. Later this data is kept in table format and train the data to predict burr formation using Convolution Neural Network (CNN).

Index Terms: Milling, Convolution Neural Network (CNN)

I. INTRODUCTION

Now-a-days Technology is growing in all fields with automation, Machine learning, Security etc.. Automation is being developed in many sectors to reduce the human effort and error.

What is milling? Milling is used to removal of metal form work piece using a machine tool which has several points with its rotating axis. Micro milling has become one of the advance technologies where it is used to cut the materials into small parts i.e. (micrometers or Millie meters) and complex structures into small parts. This technology is mainly used in electric fields, aerospace, medical, biomedical etc. High precision, low cost, three-dimensional cutting capability are the advantages of micro milling. Computer numerical Control (CNC) is the modern milling machines that does the work automatic by reducing repeatability and precision, by reducing human effort/error with advanced capabilities. CNC can remove a part of piece from three-dimensional material/structure.Fig.1 is the image of Computer Numerical Control (CNC)



Fig. 1. Computer Numerical Control (CNC)

The formation of ridges on metal is known as Burr. Micro fluidic lab-on-chip (LOC) is a toolbox which is used to manipulate small fluidic volumes in science and chemical .it offers the disposable devices with high through put, less time and low consumption. Polymeric LOC is based on the molds. molds re- quire different manufacture process based on the structure the molds can decrease

the size between 20 and 50 micrometers. This paper studies about the milling of polymeric substance and the calculating the accuracy, precision using Convolution Neural Network (CNN). Here for the experimental analysis, we have taken plastic as the substance i.e. PMMA/ PC due to its low cost and high volume manufacturing process. The below image Fig.2 shows the microscopic image of the burr

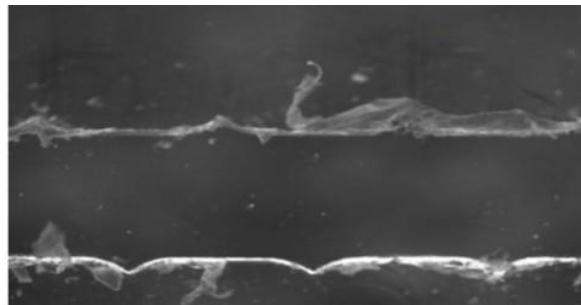


Fig. 2. Microscopic Image of Burr

II. BACKGROUND

a) Literature Review

There are many studies on micro milling and burr formation, but the application of convolution neural network is countless, and our solution is one of them. In David.J Guckenberger paper the main focus was on the micro milling fabrication of micro fluidic device and different fabrication process. A review by Barnabás Zoltán Balázs on micro milling advantages and the future use of micro milling was explained [Balázs et al., 2021]. A research paper on Burr Formation by Sung-Lim Ko, the main focus was on the burr formation on the substances main substance was plastic which was cut using orthogonal [Ko and Dornfeld, 1991] machine into a specified shapes at the required speed cut. Introduction to Convolution neural net-work(CNN) by Keiron O'Shea and Ryan Nash discussed about the evolution of CNN ,architecture of CNN and applications of CNN.

b) Reason of using Micro milling

Plastic is the most primary option than other micro fluidics because of its properties [Guckenberger et al., 2015]. Plastic is of low cost and high-volume manufacturing process. Fabrication is the process of making something from scratch. Example: Metal Fabrication, Etymology of Fabrication.

Fabrication of Plastic can be done using different methods of fabrication like micro milling, stereo lithography, hot embossing, injection molding, etc. each of them has they own advantages and limitations but when it comes to micro milling it has unique advantage towards ultra-rapid prototyping as it is low cost, high resolution and versatility regarding material choices.

In the above-mentioned fabrication methods hot embossing and injection molding are indirect methods in fabrication process, they cut the material into parts using molds. Micro milling and Stereo Lithography are other two fabrication process which perform direct method without using molds during the fabrication process of a material. The fabrication method is chosen based some properties like technical comparison, cost comparison and quality comparison. In this study we have taken Convolutional neural network to perform the analysis accuracy, precision and recall. CNN is having many applications like image recognition, face recognition, in medical, drug discovery etc... As we collect the images of the material after fabrication process. CNN is used to check the accuracy of the outputs.

III. CONVOLUTIONAL NEURAL NETWORK

Deep Neural Network refers to an Artificial Neural Net-work (ANN) with multiple layers [Szegedy et al., 2013]. Convolutional neural network (CNN) is a part of ANN which is mainly used for visual imaginary. CNN consists of output layer, input layer and hidden layer [O'Shea and Nash, 2015]. In CNN hidden layer consists of different multiple layers i.e., convolutional layers that combines with using multiplication or dot product.

Below fig.3 is the image of convolutional neural networks. In the image we can see the input layer, hidden layer and output layer

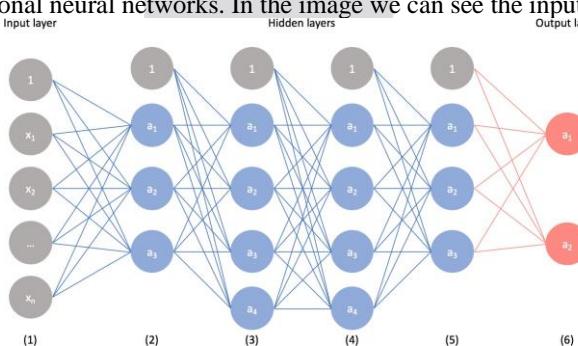


Fig. 3. Convolutional Neural Network

CNN are mostly used to solve the image recognition pattern which are complex and simple [Cos,kun et al., 2017]. In CNN every layer will have the connection from input image to the output class score. Main difference between the CNN and the traditional ANN is that CNN is mainly used for the image pattern recognition it breaks/encodes the image into an architecture and it reduce the parameters

required to set up the model. Whereas traditional ANN is that they tend to struggle with the computational complexity required to compute image data. In this project CNN is used for the image recognition to predict the accuracy.

IV.CONCLUSION

In this paper the current studies have mainly focused on the fabrication process with micro milling on plastic. Exposure to the applications of deep learning in the context of manufacturing products.

V. REFERRED WEBSITES

- i) https://en.wikipedia.org/wiki/Convolutional_neural_network#Definition
- ii) <https://studybuff.com/what-is-micro-milling/>
- iii) <https://questtech.ca/blog/what-are-the-types-of-fabrication/>: text=Common

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