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# Literature Survey for Analysis of Effect of Printing Parameters on Roundness of Fused Deposition Modeling (FDM) Parts

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***Abstract:*** A current manufacturing area focuses on various methods which can manufacture products with fine accuracy and quality with low wastage of material. Additive manufacturing also known as Rapid Prototyping is the technology which can accomplish demands of today's manufacturing industries. Fused Deposition Modelling is a one of the subtypes of 3D printing processes from additive manufacturing family to build polymer as well as metal components with greater accuracy with almost insignificant wastage of material.

***Index Terms*** -3D Printing, Roundness, Fused Deposition Modelling, Dimensional Accuracy, Geometric Tolerance

## I. INTRODUCTION

Rapid prototyping is an advanced manufacturing practice that consists of various technologies and methodologies for developing components for a variety of end implementations. Fused Deposition Modelling (FDM) is a rapid prototyping methodology for 3-D printing of thermoplastics [1]. The components fabricated using Fused Deposition modeling (FDM) have remarkable effect of Process parameters on Dimensional Accuracy [2]. The working of FDM depends on process parameters like layer thickness, infill pattern, bed temperature, print speed and infill percentage. By selecting proper process parameters, the required Dimensional Accuracy and Quality of printed parts can be achieved with consumption of proper time, cost, and wastages.[3] The steps in involved 3D printing are shown in Figure 1.1. The process of 3D printing starts with generation of CAD model of an object to be printed. The second step, convert the CAD file into STL format. This format is chosen from the name stereolithography (STL) which is the first additive manufacturing process. In third step pre-processing software slices the STL model into a number of thick layers. The thickness here may be defined depending on the application of model. Here a support is also generated which will support the model during the actual manufacturing. This is very important when manufacturing delicate parts. The last two steps are layer by layer construction of model and its cleaning and finishing [3,4]. Geometric tolerance is a vital criterion for determining the functionality of products manufactured for industry applications which include shafts, bearings, pulleys. Therefore, selection of particular set of process parameters is essential for better geometric properties and applicability.

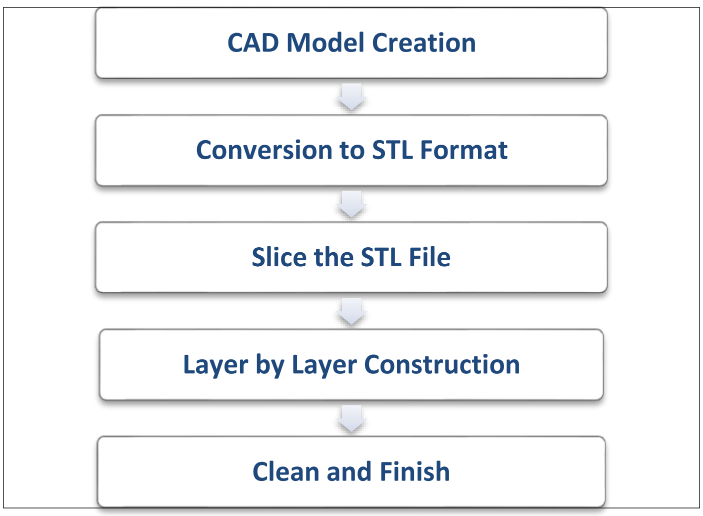


Fig.1.1. Steps in 3D printing [4]

Boschetto and Bottini [6,7] discussed how the orientation of pieces has a significant effect on geometrical errors. Vertical walls had the smallest deviations, according to the findings. A smaller or larger angle than 90° results in increase in deviations. Using Design of Experiment (DoE) methodologies, Sood et al. investigated the effect of various factors on geometrical accuracy and discovered significant factors and effective parameter configurations to reduce geometrical deviations [8,9]. Mahesh et al. [10] presented a geometry defined by flexible form surfaces that exhibit variations from nominal dimensions ranging from 5% to 15%. In one case the shape distortion caused a 2.5 mm divergence. So far, the effect of process parameters on geometrical precision has only been examined briefly. Dimensional tolerances are studied with two aims: methodical establishment of dimensional tolerances for additive manufacturing processes and optimization of machine parameters and manufacturing impacts to reduce dimensional deviations [11]. The dimensional correctness of a component part is measured by its size (size tolerance) and shape (geometric tolerance, including form, orientation, and location), as per present dimensioning and tolerance standards [12,13]. We solely addressed size variation in roundness of component and diameter for the convenience. Size variation is very vital when fitting component parts together since size has a direct impact on clearance conditions. Ollison and Berisso [14] investigated cylindricity errors and the impacts of build direction, printhead life, and feature size on cylindricity. They made two components with diameters of 0.75 and 1 inch and with three different orientation angles of 0, 45, and 90 degrees. They performed an ANOVA study on the components and discovered that the cylindricity error was lowest at a build angle of 0 degrees and highest at a build angle of 90 degrees.

From literature review, it can be seen that very few research has been carried out on geometrical tolerances of cylindrical parts.

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