INVESTIGATION OF THE EFFECT OF PRINT PARAMETER ON DIMENSIONAL ACCURACY FOR FUSED DEPOSITION MODELLING (FDM) 3D PRINTER

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Abstract

This paper is to study on the effect of print parameters on dimensional accuracy using Fused Deposition Modelling (FDM) in three-dimensional (3D) printing. Generally, FDM is one of the most popular methods for manufacturing 3D printed parts due to its vast availability. Hence, the material chosen as a matter of study in this research is known as Polylactic acid (PLA). For this study, the nozzle diameter for all specimen is set constant at 0.4 mm. Thus, the method used to measure the printed sample is using Optical Video Measuring System.After understanding the progression of the dimensional accuracy, an optimization model was created which is by using the method of Taguchi with the aim to minimize the value of the optimum parameter combination that was dependent on printing parameters which is namely as extrusion speed, extrusion temperature and extrusion rate. The optimum parameters from this study are; printing speed is 50 mm/s, nozzle temperature is 220 ˚C and feed rate is 15 mm/s.

1 Introduction

The cycle time for designing and developing a creative and innovative product has been declining since the rise of 3d printing [1]. Model can be made, and plan can be balanced or made strides in a brief period utilizing 3D printing innovation. Since 3D printer can build an assortment of objects with given opportunity of plan, this has given way to incorporate more load-bearing portion that are imaginatively outlined for the needs of the user that offer function. In any case, the need of data for mechanical properties of PLA 3D printed parts and the printer parameter optimization data utilizing low-cost 3D printer has been an impediment for the users to survey the potential of the printer in creating an expecting item with required mechanical property [2]. However, the difference of its impact on the mechanical properties of an items when utilizing diverse 3D printer is still an existing issue [3].

The efficiency accuracy of fused deposition modelling (FDM) is influenced by extruder temperature nozzle feed rate [4]. The effects of extrusion angle, layer gap, nozzle diameter, and layer thickness, extrusion angle on FDM printed products were determined with the optimal values for these parameters [5]. The layer thickness, part build orientation angle, raster width effects, raster angle, raster gap, part build orientation angle, and as well as the part build orientation angle's interaction that also can affect the accuracy. When the nozzle temperature during printing process increases, the melt viscosity of PLA decrease which result in better diffusion of newly extruded PLA molecules in underlying layer which in turn results in a stronger interlayer adhesion [6]. Most extruder design use a thermistor for temperature measurement, but it may differ in terms of the placement of the thermistor compared to the heating elements and nozzles. As the speed of the print head increments, more force begins to construct up, which often leads to a jerky development. This will cause ringing in your prints and other comparative defect. The lower feed rate speed plays an important role in pushing the filament into the extruder head [7].

To regulate the impact of printing settings on dimensional accuracy, the Taguchi method will be used. Extrusion speed, extrusion rate, and extrusion temperature are the printing parameters investigated in this study. Importantly, this