Evaluation of the surface roughness and dimensional accuracy of low-cost 3D-printed parts made of PLA-aluminum

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Source HELIYON
Volume: 10 Issue: 4
DOI: 10.1016/j.heliyon.2024.e25508

Article Number e25508

Published FEB 29 2024

Early Access FEB 2024

Document Type Article

Abstract Fused deposition modeling (FDM) is currently used in several fields, such as architecture, manufacturing, and medical applications. FDM was initially developed to produce and create prototypes, but the expense appears excessive for producing final products. Nevertheless, in this day and age, engineers have developed a low-cost 3D printer. One of the major issues with lowcost 3D printers is the low dimensional accuracy and high tolerances of the printed products. Herein, different printing parameters, i.e., layer thickness, printing speed, and raster angle, need to be investigated to enhance the surface roughness of the parts produced using FDM. Thus, the present study focuses on investigating the performance of the surface finish produced by FDM by manipulating different parameters such as layer thickness, printing speed, and raster angle. Taguchi's method, based on the L9 array for experimental design, was employed to elucidate the response variables. The sample model was developed following ISO standards, utilizing polylactic acid (PLA)-aluminum as the filament material. The analysis of variance results indicated that the layer thickness and raster angle significantly affect the surface roughness of the printed parts, with statistical P-values of 0.016 and 0.039, respectively. This enables an easy selection of the optimal printing parameters to achieve the desired surface roughness. The dimensional accuracy of

the fabricated part was also evaluated. Thirteen dimensions of the part features were analyzed, and the results showed that the FDM machine exhibited good accuracy for most of the shapes, with a deviation below 5%.

Accession Number	WOS:001188662500001
PubMed ID	38384568
eISSN	2405-8440

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