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Multi-objective Optimization on Dimensional Accuracy, Edge and Surface Quality of 3D-Printed Parts by Fused Deposition Modelling

BY

Islam Hamdy Salem

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Under the supervision of:

Dr. Mohamed Fawzy Aly

Associate Professor, Department of Mechanical Engineering

The American University in Cairo

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ABSTRACT

Fused Deposition Modelling (FDM) is one of most common additive manufacturing (AM) techniques used in manufacturing field. It has been increasingly used because of its low cost and simplicity. Although FDM can save time through eliminating pre-processing tooling-up to produce the end-user product, still a better final product quality, like mechanical properties, dimensional accuracy and surface finish, is needed. This thesis addresses the maximization of involved printing parameters in one reliable model. Hence, a wider investigation is conducted in this research via experimental work in order to obtain a comprehensive model that involves and relates more parameters in a single model. A full factorial 2-level DOE is used for 6 printing parameters; layer height, wall thickness, bottom/top thickness, infill density, temperature and printing speed. The results of experiment were analyzed using ANOVA analysis, and the regression models were developed. The regression models showed some weakness in the goodness of fit due to the large number of hidden variables and uncertainty of the FDM process. Layer height, wall thickness, infill density, printing speed and their interactions were found to be the most influential on the dimensional accuracy, edge quality and surface quality. Finally, the obtained regression models were optimized by two different multi-objective optimization techniques, and the optimal printing parameters were identified and tested.