

Optimization of FDM process parameters to minimize surface roughness with integrated artificial neural network model and symbiotic organism search

Abstract

Fused deposition modeling (FDM) has shown to be a highly beneficial process for product development. However, one of the great challenges in using FDM is maintaining the surface quality of the produced part. Poor texture quality can be regarded as a defect. It is not part of the geometric prototype but results from the fabrication process. Poor input parameters typically cause these defects by the user. This paper presents the integration between an artificial neural network (ANN) and symbiotic organism search, known as ANN–SOS, to model and minimize the surface roughness (R_a) of the FDM process. The FDM input parameters considered were layer height, print speed, print temperature, and outer shell speed. The experimental data were collected using the central composite design response surface method. Then, the surface roughness model was established using an ANN. After validating the model's accuracy, it was combined with symbiotic organism search (SOS) to determine the optimal parameter settings for the minimum surface roughness value. The results illustrate that ANN–SOS with a 4-8-8-1 network structure would be the best model for surface roughness prediction. It was observed that decreasing the layer thickness, printing speed, print temperature, and outer shell speed of the FDM input parameters for ANN–SOS resulted in minimum surface roughness of approximately 2.011 μm , which was 12.36% better than the RSM method.

Keywords

Artificial neural network (ANN); Fused deposition modeling (FDM); Surface roughness; Symbiotic organism search (SOS)