Investigation of 3D Printing Process Via Meshless Analysis and Experiment Technique

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Abstract: 3D printing technology is mainly designed to fabricate irregular-shaped targets, but it undergoes an issue of unavoidable thermal residual stress and may induce serious warping and distortion. To guarantee the quality of the printing 3D irregular-shaped parts, a novel meshless analysis procedure is therefore established in this work. With certain checking mechanisms devised, the nodes used by the meshless analysis are appropriately chosen to represent the irregular geometry of printing parts and fit the growing situation in the printing process. As verified by the temperature measurement in the printing process, uniform temperature of each layer is assumed and the thermal analysis can be performed on layer-by-layer basis. As the Young's modulus of the PLA material is relatively stable under the glass transition temperatures, the Young's modulus is assumed as temperature independent. Based on the stress-strain behavior of the PLA material tested in this work, only linear elastic thermal stress analysis is performed. To demonstrate the accuracy and efficiency of the proposed techniques, the 3D PLA brick with an internal rectangular hole is tackled. The influence of different hole sizes on the deformation of the printing brick is also evaluated. Good agreement between the meshless analysis results and experiment data is drawn.

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