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PROCEEDINGS

In-Situ Process Monitoring and Quality Evaluation for Fused Deposition Modeling with Foaming Materials

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ABSTRACT

Fused deposition modeling (FDM) with foaming materials offers the capability to generate internal porous structures through in-situ foaming, imparting favorable characteristics such as weight reduction, shock absorption, thermal insulation, and sound insulation to printed objects. However, the process planning for this technology presents challenges due to the difficulty in accurately controlling the foaming rate, stemming from a complex underlying mechanism that remains poorly understood. This study introduces a multi-sensor platform for FDM with foaming materials, facilitating in-situ process monitoring of temperature field information during material modeling and quality evaluation of printed objects, i.e., abnormal foaming and foaming rate. An infrared camera, integrated with the printing head, locates the instantaneous deposition area during the printing process by analyzing displacement distance and direction of characteristic points in thermal images from two consecutive frames. The temperature field is continuously monitored throughout the printing process to accurately identify the locations of abnormal foaming. A two-dimensional laser sensor quantifies the surface abnormal foaming and provides specimen volume information. This, combined with the weight information of consumable material obtained from a weighing sensor on the material tray, enables in-situ evaluation of abnormal foaming and foaming rates. Finally, the feasibility and accuracy of this in-situ process monitoring and quality evaluation method are validated with specimens with various infill patterns.

KEYWORDS

Fused deposition modeling; foaming materials; in-situ process monitoring; quality evaluation; multi-sensor

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