

PROCEEDINGS

A Novel Curvature-Adaptive Printing Strategy for Continuous Carbon Fibre Composites with Complex Fibre Trajectory

Yusi Wang¹, Zheng Bian¹ and Yuan Chen^{1*}

¹School of Automation and Intelligent Manufacturing (AiM), Southern University of Science and Technology, Shenzhen, 518055, China

*Corresponding Author: Yuan Chen. Email: chenyan@sustech.edu.cn

ABSTRACT

P Fused filament fabrication (FFF) enables rapid manufacturing of continuous carbon fibre reinforced composites (CCFRCs). However, the FFF technology usually brings about CCFRCs with complex fibre trajectories, i.e., curvature, etc., triggering poor forming quality with excessive pores and low mechanical performance. This study adopts porosity as the core evaluation indicator, develops a predictive model based on response surface methodology (RSM), and constructs a multi-objective optimization framework to formulate a curvature-adaptive variable-speed printing strategy for CCFRC fabrication. Optimised processing parameters for diverse curvature conditions are obtained via intelligent algorithms. Experimental results confirm the superiority of the proposed method in defect elimination, achieving simultaneous improvements in surface morphology and mechanical performance of CCFRCs. A multi-scale model is established based on representative volume elements (RVE) to further reveal the cross-scale mechanism linking pore distribution and structural mechanical performance under variable-speed printing. This study achieves coordinated optimisation of forming quality and mechanical performance, providing practical guidance for the high-quality 3D printing of CCFRCs.

KEYWORDS

CCFRCs; RSM; multi-objective optimization; variable-speed printing; multiscale modeling

Funding Statement: This work was supported by the National Natural Science Foundation of China (12302177), the Guangdong Basic and Applied Basic Research Foundation, China (2024A1515010203), the Guangdong University Key-Area Special Program, China (2023ZDZX2025), the Shenzhen Science and Technology Program, China (JCYJ20230807093602005) and the Shenzhen Key Laboratory of Intelligent Manufacturing for Continuous Carbon Fibre Reinforced Composites, China (ZDSYS20220527171404011).

Conflicts of Interest: The authors declare no conflicts of interest to report regarding the present study.



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