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Physics-Informed Neural Networks (PINNs) for Improving a Thermal Model in Stereolithography Applications

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Abstract

Stereolithography (SLA), additive manufacturing (3D printing) technique, is widely used nowadays for rapid prototyping and manufacturing (RP&M). This technique is driven by photo-polymerisation, which is an exothermal process. This may lead to thermal stresses significantly affecting the final quality of printed parts/products. To guarantee high-quality parts printed with the SLA technique, understanding the thermal behaviour is therefore crucial for optimizing the process. In this paper, the recent physics-informed neural network (PINN) methodology was employed to improve a physics-based model for predicting the thermal behaviour of SLA processes. The accuracy of the improved thermal model is demonstrated in this paper by comparing the predicted 2D temperature field with the 2D temperature field measured by a high-speed infrared thermal camera on parts printed on a production machine.

Keywords: Physics-informed neural network (PINN); Stereolithography (SLA); Thermal model; High-speed thermal imaging