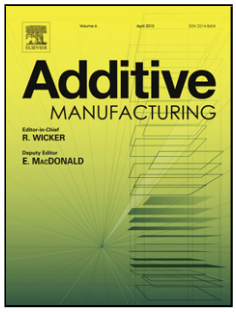

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Thermomechanical model development and in situ experimental validation of the Laser Powder-Bed Fusion Process

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Abstract

A three-dimensional finite element model is developed to allow for the prediction of temperature, residual stress, and distortion in multi-layer Laser Powder-Bed Fusion builds. Undesirable residual stress and distortion caused by thermal gradients are a common source of failure in AM builds. A non-linear thermoelastoplastic model is combined with an element coarsening strategy in order to simulate the thermal and mechanical response of a significant volume of deposited material (38 layers and 91 mm^3). It is found that newly deposited layers experience the greatest amount of tensile stress, while layers beneath are forced into compressive stress. The residual stress evolution drives the mechanical response of the workpiece. The model is validated by comparing the predicted in situ and post process distortion to experimental measurements taken on the same geometry. The model accurately predicts the distortion of the workpiece (5 % error).

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