Predictions of Melt Pool Depth in Laser Powder Bed Fusion using Gaussian Process

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Abstract

In this work, the remelted depth of single track in laser powder bed fusion (L-PBF) process at various combinations of laser power and laser scanning speed is predicted using Gaussian process (GP) regression model. First, the melting process of laser powder bed fused 316L stainless steel is simulated by coupled fluid-thermal model. The resultant remelted depth can then be measured. Subsequently, a GP regression model is trained by the simulation predictions in order to generate a regression surface, which generalizes the predictions to any unobserved settings. As a result, the predictions made by the GP regression model are in good agreement with experimental observations. The error magnified by GP is considerably small, indicating the adequacy of GP. The GP regression model enables designers to determine optimal processing to avoid pores formation in keyhole mode.

Keywords: additive manufacturing; Gaussian process; machine learning; powder bed fusion