Detection and classification of defects in selective laser melted 316L stainless steel based on convolutional neural network

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Abstract

Selective laser melting (SLM) is widely used to fabricate metal materials with super mechanical properties. However, it is difficult to achieve full density of 100% due to defects generated in the SLM process, such as porosity, lack-of-fusion (LOF), and crack. These flaws are detrimental to mechanical properties of metal parts. Therefore, the defect analysis is crucial to the optimization of SLM process parameters and prediction of mechanical properties. In addition, it is time-consuming to identify and quantify these defects manually, which also lacks consistency and reproducibility. As such, this paper presents a pre-trained convolutional neural network (CNN) for automated detection and classification of the above defects, in which several hundreds of patches are input from light-optical images of selective laser melted 316L stainless steel and then the defect category is determined as the output. It is demonstrated that a robust and reliable model is useful to obtain the information on the defects, such as category, density, and distribution quickly and accurately.

Keywords: Selective laser melting, 316L stainless steel, defects, convolutional neural network, light-optical images, detection and classification