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USING MACHINE LEARNING TO OPTIMIZE LASER-POWDER BED FUSION (L-PBF) PARAMETERS OF METALLIC MATERIALS

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ABSTRACT

The final properties of parts made via laser-powder bed fusion (L-PBF) are extremely sensitive to the processing parameters such as power, time exposure, hatch distance etc. As such, it is a significant challenge to identify the optimal operating parameters to produce parts rapidly and reliably with the desired properties without defects [1]. Artificial intelligence (AI), and in particular machine learning, is an innovative tool that can be employed for process optimization and predicting the microstructural and mechanical properties of fabricated parts [2]. However, to generate a robust machine learning model, sufficient amount of training data is required, which is time-consuming and very expensive, particularly in L-PBF. In this study, transfer learning artificial neural network (TR-ANN) is proposed to overcome such inconvenience and optimize the processing parameters in AlSi10Mg alloy for additive manufacturing [3]. Firstly, the base model will be trained using data from literature to generate the processing window, and next, training of the target model will be carried out by experimental data from printed AlSi10Mg samples. The TL-ANN models predicted the density, melt pool depth, and melt pool width of the AlSi10Mg printed parts with an R^2 score of 0.977, 0.966, and 0.987, respectively. In addition to validate the performance predictions made by the TR-ANN machine learning model, this approach is generalized for different metallic materials, such as SS316L and a new aluminium alloy (AlFeCrSi) specifically designed for L-PBF.

KEY WORDS: Machine learning, Artificial neural network, Transfer learning, LPBF, AlSi10Mg, SS316L; AlFeCrSi.

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