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Handling Editor

Materials Science and Technology

To whom it may concern,

We would like to submit the manuscript, “Classification of Microstructural Defects in Selective Laser Melted Inconel 713C alloy using Convolutional Neural Networks” by Edmunds and Thomas, for consideration for publication in Materials Science and Technology. All authors have read the manuscript and confirm its originality.

This work advances previous studies, published in Materials Science and Technology, which utilised supervised machine learning to classify microstructural defects — namely, 'crack', 'pore', 'pore with crack', and 'lack of fusion' — in micrographs of additively manufactured nickel-alloys.

In our study, we propose and evaluate the use of Convolutional Neural Networks to as an alternative method to automated microstructural defect classification for additively manufactured nickel-alloys. We collected and segmented micrographs of various Inconel 713C alloy, which were produced using Selective Laser Melting with varied settings of power, beam velocity, and hatch spacing. The segmentation resulted in the creation of a dataset containing 4800 binary images of commonly found defects – ‘crack’, ‘pore’, ‘lack of fusion’, and ‘pore with crack’.

Using this dataset, we designed a neural network architecture to classify each type of defect. Additionally, we used various hyperparameter optimisation techniques, such as grid search and Bayesian optimisation, to optimise the neural network architecture for optimal classification performance.

In the work, data augmentation methods were used to artificially expand the dataset, to address imbalances in the respective defect classes. The modified datasets, produced using data augmentation, were used to train neural networks. The networks produced using both the original dataset and modified datasets were compared using Matthew’s Correlation Coefficient,

We believe that the submission conforms to all the necessary format requirements for the Journal of Materials Science and Technology. The word count of this manuscript is approximately4900 words (including references, front matter, tables and captions).

Yours sincerely,

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