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Artificial Neural Network-Based Process Recommender System for Addictive Manufacturing

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Extended Abstract

3D printing is a rapid and cost-effective manufacturing process widely used for small-scale customized production [1-4]. However, depending on the target product, optimizing process conditions may be required, which can be time-consuming and costly [5, 6]. Moreover, optimization efforts relying on trial-and-error methods are even more time-consuming than simulation or technical approaches for process optimization [4, 7].

This study focuses on the development of a process recommender system for 3D metal printing using an artificial neural network. The dataset consists of five input parameters, including laser power, scan speed, hatching angle, hatching distance, and layer thickness, and one output parameter, which is density. To achieve optimal efficiency with minimal data, the training dataset was designed using Taguchi and random sampling methods. Four processing conditions and three levels based on L9 orthogonal arrays were employed to collect the dataset. The correlation between inputs and output of the collected data was analyzed.

The AI model for the artificial neural network was developed through hyperparameter tuning, considering the optimizer, loss function, learning rate, activation function, and others. In addition, the cross-validation method was used to overcome a small number of data. Sensitivity analysis was conducted to identify the main processing conditions for the prediction model. Based on the developed AI model, it becomes possible to predict the density for a given process condition. However, the ultimate goal of this study is to derive the optimal process conditions to achieve the desired density. Therefore, a recommender system was developed using the random search method to suggest the optimal process conditions.

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