

Prediction and Optimization of MIG Welding Parameters using Random Forest Regression and Pareto Front Analysis

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Abstract

MIG welding is widely used in industries and optimization and selection of correct set of welding parameters is very much essential for quality welds to be produced. In the current experiments firstly machine learning algorithm random forest regression has been applied for prediction and optimization of welding parameters. For comparison and better performance Pareto front analysis was performed on top of it. The performance and results has been explained through visualization for better understanding and gaining insight. It was found that random forest regression performed quite well despite limited number of dataset.

Keywords: Machine Learning, GMAW, Random forest, Pareto front, prediction, optimization.

1. Introduction

For optimizing welding parameters various techniques have been applied by various searchers throughout the world. For this purpose techniques like multiple linear regressions (MLR) have been used extensively. Jayant et al [1] applied analytic hierarchy process for selection of best welding process for welding of high pressure vessels. Twelve competing parameters were chosen for the multi criteria decision making process. Jeet et al [2] applied TOPSIS for optimizing the multi response process of GAMW while welding disparate metals SS202 and AISI 1018. They also developed a predictive model by genetic algorithm and applied simulated annealing for optimization. Bhattacharya et al [3] applied AHP for optimizing process parameters of MIG welding for welding high carbon steel. Zhu et al [4] first applied Douglas-Puke algorithm to extract features points for weld quality. For online monitoring of weld quality they relied on random forest regression (RFR) ensemble learning and also compared the result with ID3 algorithm of decision tree. They found that accuracy of RFR was quite higher than ID3 or CART algorithm. Munghate et al [5] predicted bead geometry using machine learning algorithm while TIG welding austenitic steel. They applied classification models RFR to predict the bead geometry fittingly. Proper correlation was also established between flux deposition, process parameters and bead geometry. Based on random forest approach Babaiyan et al [6] developed a hybrid mishmash of SVM (support vector machine) and RVM (relevance vector machine) for predicting precise weld bead geometry of GMAW process. Their proposed model was highly