AI-Based Optimization of Welding Process Parameters for Maximizing Quality

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Abstract

Artificial Intelligence (AI) plays an increasingly essential role in optimizing manufacturing processes, where precision and quality are critical. This study employs the Grey Wolf Optimizer (GWO), a meta-heuristic inspired by grey wolves, to optimize critical parameters in the submerged arc welding (SAW) process. The GWO is applied to minimize bead width, a key quality indicator while balancing influential parameters such as current, voltage, and welding speed. GWO's performance is compared to the established Rao method, which has demonstrated effective results in welding applications. Both methods are assessed based on varying population sizes and iteration counts to evaluate parameter convergence across two distinct scenarios. Results indicate that GWO achieves precise parameter estimation and demonstrates efficiency in complex, non-linear optimization challenges within the welding process. This research highlights GWO's potential as an AI-driven approach to advancing welding quality and consistency, establishing a foundation for wide applications in industrial optimization.

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