

OP 038

AI Driven Autonomous Adaptive Feedback Welding Machine

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The mechanized Gas Tungsten Arc Welding (GTAW) process has gradually evolved into the primary method for nuclear component fabrication and repair. Recent advancements in monitoring and automation technologies have made the shift toward fully automated machine arc welding more feasible, reducing the necessity for continuous human oversight. The newly developed mechanized GTAW system is equipped with comprehensive encoder feedback incorporating a camera, microphone, and laser profilometer. The system boasts an automated homing sequence that precisely aligns the electrode within the groove and employs an automated wire dripping detection control loop utilizing acoustics. Furthermore, we present an image-based neural network, trained on real-time monitoring of welding parameters, that identifies crucial features such as the weld pool, groove, wire, and electrode. A closed-loop control ensures a consistent wire position in the weld pool, compensating for wire cast and other unforeseen disturbances. A separate neural network, trained on weld telemetry settings, electrode positioning, groove pre-scans, and post-scan analysis of weld beads, accurately predicts the weld bead profile for multi-pass welds and inconsistent groove geometries. Integration of both open and closed control loops enables autonomous planning and execution of multi-pass welds to fill grooves.