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Experimental investigation and multi-objective optimization of micro-wire electrical discharge machining of a titanium alloy using Jaya algorithm

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ABSTRACT

Micro-wire electrical discharge machining (Micro-WEDM) process exhibits superior precision and greater relative accuracy for the efficient machining of difficult-to-machine materials. The micro-slit cutting operation using WEDM process has been experimentally investigated for the objective of analysing the average kerf-loss and responses pertaining to the economic viability of the process viz. average cutting rate and volumetric material removal rate (MRR_v). The experiments are performed using a Tungsten wire of diameter 70 μm on titanium grade 5 alloy (Ti-6Al-4V). Three different controllable process variables (input parameters) associated with the Resistance-Capacitance (RC) based power generator namely discharge energy, wire feed-rate and wire travelling speed are varied to demonstrate their impacts on typical responses such as average kerf-loss, average cutting rate and MRR_v. The experimental analysis revealed a close relationship that cutting rate bears with discharge energy, wire feed-rate and efficient flushing of molten liquid as well as fine debris particles. An advanced multi-objective optimization technique popularly known as Multi Objective-Jaya (MO-Jaya) algorithm has been adopted for the simultaneous optimization of average kerf-loss, average cutting rate and volumetric material removal rate. The best set of input parameters have been selected to suggest the most optimum responses for micro wire-cutting operations.

ARTICLE INFO

Keywords:
Micro-wire electrical discharge machining (Micro-WEDM);
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