Regular article

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PII: S1350-4495(17)30700-4
DOI: https://doi.org/10.1016/j.infrared.2018.01.028
Reference: INFPHY 2486

To appear in: *Infrared Physics & Technology*

Received Date: 24 October 2017
Revised Date: 23 January 2018
Accepted Date: 23 January 2018

Please cite this article as: P. Kumar Shrivastava, A. Kumar Pandey, Geometrical Quality Evaluation in Laser Cutting of Inconel-718 Sheet by using Taguchi based Regression Analysis and Particle Swarm Optimization, *Infrared Physics & Technology* (2018), doi: https://doi.org/10.1016/j.infrared.2018.01.028

Geometrical Quality Evaluation in Laser Cutting of Inconel-718 Sheet by using Taguchi based Regression Analysis and Particle Swarm Optimization

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Abstract: The Inconel-718 is one of the most demanding advanced engineering materials because of its superior quality. The conventional machining techniques are facing many problems to cut intricate profiles on these materials due to its minimum thermal conductivity, minimum elastic property and maximum chemical affinity at magnified temperature. The laser beam cutting is one of the advanced cutting method that may be used to achieve the geometrical accuracy with more precision by the suitable management of input process parameters. In this research work, the experimental investigation during the pulsed Nd:YAG laser cutting of Inconel-718 has been carried out. The experiments have been conducted by using the well planned orthogonal array L_{27}. The experimentally measured values of different quality characteristics have been used for developing the second order regression models of bottom kerf deviation (KD), bottom kerf width (KW) and kerf taper (KT). The developed models of different quality characteristics have been utilized as a quality function for single–objective optimization by using particle swarm optimization (PSO) method. The optimum results obtained by the proposed hybrid methodology have been compared with experimental results. The comparison of optimized results with the experimental results shows that an individual improvement of 75%, 12.67% and 33.70% in bottom kerf deviation, bottom kerf width, and kerf taper has been observed. The parametric effects of different most significant input process parameters on quality characteristics have also been discussed.

Keywords- Inconel-718; Parametric Optimization; Hybrid approach; Multiple Regression Analysis; Particle Swarm Optimization; Parametric effects;