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# An Integrated Multi Response Taguchi- Neural Network- Robust Data Envelopment Analysis Model for CO<sub>2</sub> Laser Cutting

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## Abstract

Taguchi method is a common method for controlling quality in off-line mode. Initially, this method is introduced to optimize a quality characteristic. Since optimizing one aspect of quality may deteriorate other aspects, so, to overcome this shortage, multi response Taguchi (MRT) method is extended. In MRT method, due to the existence of some uncontrollable factors or impossibility of implementing all the experiments, just some of the experiments are implemented and other experiments are designed by neural network (NN) technique. It is clear that there is uncertainty in the results of NN which can lead to incorrect decision making. Hence, the robust optimization approach is used to handle uncertainty in NN results. In this paper, first, the experiments are designed by the Taguchi method, then some experiments are implemented and other experiments are estimated by a back-propagation neural network (BPNN) technique. Finally, the best combination of quality parameters is selected by using optimal robust data envelopment analysis (RDEA) model. To illustrate the capability of the proposed approach, the experiments are performed on a CO<sub>2</sub> laser cutting machine in a manufacturing company in Iran.

**Keywords:** Taguchi Method (TM), Design of Experiments (DOE), Neural Network (NN), Robust DEA (RDEA)

## 1. Introduction and literature review

Taguchi method (TM) is one of the most powerful statistical methods of quality improvement. It aims to improve the parameters setting to reduce deviation and variability in response indexes. Noise factors (external conditions, manufacturing imperfections, etc.) are unwanted sources of variation and can be uncontrollable or too expensive to

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