Chapter 9
Application of TOPSIS Optimization Technique in the Micro-Machining Process

Boopathi Sampath
https://orcid.org/0000-0002-2065-6539
Muthayammal Engineering College, India

Sasikumar C.
Bannari Amman Institute of Technology, India

Sureshkumar Myilsamy
Bannari Amman Institute of Technology, India

ABSTRACT

Multi-criteria optimization techniques have been applied to predict the best alternative solutions to meet the best results for all attributes. In the micro-machining processes, the various process parameters in the micro-machines, special experimental setup, tool profiles, workpiece materials, and working mediums are considered. Sometimes, the response attributes conflict with each other, making it difficult to estimate the best-influenced process parameters. The multi-criteria optimization methods are applied to solve the abovementioned conditions. In the chapter, the multi-criteria optimization technique: TOPSIS (technique for order of preference by similarity to ideal solution) implementation procedures, flowchart, and result interpretation have been demonstrated to optimize or predict the best micromachining process parameters. A case study on the application of the TOPSIS technique in electrical discharge machining (EDM)) has been illustrated.

DOI: 10.4018/978-1-6684-5887-7.ch009

INTRODUCTION

The micro-machining processes are generally playing an important contribution in the various industries to machine complicated, contour, hard, and micro-sized components. a one-of familiar type of non-conventional machining process. In this aspect, the micro-machining parameters optimization of response parameters is essential to select the required process parameters for the various machining conditions: materials, environment, and minimizing the environmental impacts. Material removal rate, surface roughness, dimensional accuracy, ovality, roundness errors, tool wear rate, tool selection, and work material are all factors to consider. Input parameters such as power, current, voltage, chemical concentration, fluid requirements, fluid pressure, flow rate, material hardness, and parameters related to non-renewable energy sources are also considered. The material removal process is done by applying periodic intervals of an electric pulse during the machining process. The selection of suitable process parameters for the various industrial requirements is essential to minimize the workload of machine operators, improve quality and enhance productivity. Thus, the optimization techniques play a very important role in selecting the optimum parameters in the micromachining processes. The utilization of optimum resources in the manufacturing industry leads to reducing the waste and cost of manufacturing. The different type of optimization techniques was applied to micro-machining processes to improve the machining characteristics. The multi-criteria TOPSIS optimization method plays a very important role in the optimization of the various micro-machining processes. In this chapter, the electrical discharge machining process is selected as a case study to illustrate the implementation, analysis, and prediction procedures of the TOPSIS technique.

The Technique for order of preference by similarity to ideal solution (TOPSIS) is one of the multi-response decision-making techniques that is utilized to forecast the optimum solution to the multiple responses. In this study, the TOPSIS technique has been applied to estimate the best combination of operating parameters (Boopathi, 2013; Boopathi & Sivakumar, 2013, 2016a). In the 1980s, it was established by Hwang and Yoon for optimization problems. It is based on the Euclidean distance method, which finds the relative closeness of each factor to the ideal solutions. Initially, it converts the dimensional factors to unidimensional or dimensionless factors. Two alternative solutions have been made for the maximization and minimization of responses with respect to ideal solutions. Positive Ideal Solutions (PIS) were obtained for the expectations of maximising the responses. In this case, Negative Ideal Solutions (NIS) were obtained with the expectation of minimizing the responses. If the obtained solutions have a short distance from PIS and a long distance from NIS, it is selected as the best solution. In TOPSIS, the beneficial output is related to maximizing the responses, and non-beneficial output is related