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Chapter VIII

Applications of Artificial Intelligence in the Process Control of Electro Chemical Discharge Machining (ECDM)

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Abstract

This chapter presents the applications of artificial intelligence (AI) in the process control of electro chemical discharge machining (ECDM). The performance of the ECDM process depends on the pulse shape of the voltage and current waveforms. However, the type of the pulse and shape of the voltage and current waveforms are highly nonlinear and complex in nature. Therefore, the intelligent pulse classification systems are required for the achieve-

ment of better performance of the ECDM process. The aim of the study is to investigate the most suitable pulse classification architecture which provides the better classification accuracy with the minimum calculation time. A neural network pulse classification system (NNPCS), a fuzzy logic pulse classification system (FLPCS), and a neuro fuzzy pulse classification system (NFPCS) were developed for the pulse classification of the ECDM process. However, the NNPCS was selected as the most suitable pulse classification system for the ECDM process control system as it provides the smallest calculation time and reasonable classification accuracy.

Introduction

Fierce competition and higher customer expectations are forcing manufacturing businesses to improve quality, lower selling price, and shorten time to market. To achieve such objectives, novel techniques and tools are used in the manufacturing industry. Artificial intelligence (AI) is a novel technique that is becoming popular in various industrial applications to increase efficiency and quality and reduce the cost of production. Since the early 1960s, AI has found its way into industrial applications, mostly in the area of expert knowledge-based decision-making for the monitoring and controlling of manufacturing processes. That fact has been enhanced with advances in computer technology and the advent of fast micro-processes. The concept of intelligent control was first introduced in late 1970s. In recent years, intelligent control has emerged as one of the most active and fruitful areas of research and development within the spectrum of engineering disciplines with a variety of industrial applications.

Various manufacturing processes, such as machining, casting, forming, forging, spinning, and fabrication, are employed in the manufacturing industry. The conventional machining processes are often based on removing materials using tools harder than the workpiece. However, there are many limitations of such conventional machining processes when advanced and hard materials (e.g., hastalloy, nimonic, etc.) are to be machined economically. Unconventional manufacturing processes, such as electro discharge machining (EDM), electro chemical machining (ECM), and so forth, are used to machine very hard materials that are difficult to machine with conventional machining processes. Electro chemical discharge machining (ECDM) combines the features of EDM and ECM. Due to the inherent complex nature of the ECDM process, the applicability of conventional control approaches, which are used in ECM and EDM, are limited. Therefore, there is a need for more advanced intelligent process control approaches to improve the performance of the ECDM process. The prime objective of this chapter is to present the applications of AI in the process control of ECDM.

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