Chapter 8
A Review of Artificial Intelligence Technologies to Achieve Machining Objectives

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ABSTRACT

Bridging the design, planning and manufacturing departments of a production enterprise is not a conclusive effort for the implementation of computer integrated manufacturing. Continuous interaction and seamless exchange of information among these functions is needed and requires the maintenance of a large database and user-friendly search and optimization techniques. Among several artificial intelligence techniques capable of the above task, four important and popular ones are, expert systems, artificial neural networks, fuzzy logic and genetic algorithms. In this chapter, these four techniques have been conceptually studied in detail and exemplified by reviewing an application in the manufacturing domain. Successful implementations of artificial intelligence that are recently reported in machining domain are also reviewed, suggesting potential applications in the future.

INTRODUCTION

Decision support systems are in use in the technical domain for quite a long time. Their value would be greatly improved if they could perform a decision-making step even in the absence of a human expert, given the fact that the human thought processes can be modeled by computers. By tracking human expertise and learning their preference strategies in a competitive or tie-breaking situation, decision making could be imitated. But this exercise need not be scientific, rather it is humanistic. "The scientific approach analyzes a phenomenon in quantitative terms, and has a tendency to analyze the behavior of humanistic systems as if they were mechanistic systems…" (Zadeh, 1973). Therefore, a modern problem-solving paradigm, known as Artificial Intelligence (AI) is being practiced when working out heuristic and experiential solutions to industrial problems.

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The scope of this article is to assess the basic nature of problems faced in the production engineering domain which are sought to be solved by an intelligent manufacturing approach. This is followed by a discussion on the various AI techniques in vogue to implement intelligent manufacturing systems. Further, successful applications of AI recently reported in machining domain are reviewed.

BACKGROUND

The global research firm, Forrester says that 58% of business and technology professionals are researching AI systems and 12% are actively using them ("Power of AI," 2018). Accenture research on the impact of AI in twelve developed economies extrapolated a significant boost in labour productivity of up to 38% in 2035 (Purdey, 2016). Using AI, manufacturers could make informed decisions at each stage in the production process. There are several methods by which the human problem-solving abilities are imitated; of which Expert System, Neural Network, Fuzzy Logic and Genetic Algorithm are popular. Figure 1 displays the total number of published works, noted annually, featuring different AI techniques, as observed from Microsoft Academic Search website. It is seen that over the last two decades, neural network and genetic algorithm are used by researchers in large numbers, compared to knowledge-based system and fuzzy logic technique.

Technologies based on AI are helping to ease and uplift the living standards of human life, in many cases even we not being aware of it. Nowadays in the medical field, devices are produced with embedded software incorporating expert systems or neural networks for the automatic interpretation of clinical electrocardiograms (Celler, 1997). Banks and insurance firms could detect fraud and misappropriation through image processing and neural networks that can analyse data pattern and its day to day deviations. Genetic algorithms serve logistics planning functions in airports and factories, where they are used to help solve the resource-allocation problems. Fuzzy logic schemes are inbuilt into television sets to automatically adjust screen parameters based on ambient lighting and the time of the day.

Figure 1. Graphical presentation of total number of publications (annual) worldwide falling under the keywords 'knowledge-based system', 'artificial neural network', 'fuzzy logic', and 'genetic algorithm'
Source: Microsoft Academic Search website