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The Inevitable Role of Artificial Intelligence Emerging in Mechanical Engineering

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Abstract : *The time of artificial intelligence in mechanical engineering is here. There is a new breed of machine learning tools and techniques now available that enable mechanical engineers to explore problems never before possible. Deep neural networks have been implemented to facilitate new designs, and other machine learning methods are being used to solve previously intractable problems. One reason for this increase is because computer-aided technology is a rapidly advancing field and is able to complete tasks that were once only possible using manual labour. The primary advantages of using artificial intelligence to solve mechanical engineering problems are related to the iterative process between problem definition and design solution. Iteration is important to the design process because it allows the engineer to refine a design before any materials have been cut or used. This paper delves deep into the fields where predominantly AI is going to emerge successfully.*

Keywords - *Artificial Intelligence, Neural Network, Mechanical Engineering, Rapid Growth, Computer Learning*

I. INTRODUCTION

Artificial intelligence technology plays an increasingly important role in people's lives as it is more widely used in people's daily life. For example, the common use of smart dishwashers and smart sweepers, which are products of the interfusion of artificial intelligence and mechanical manufacturing industry, guarantees the accuracy of manufacturing, improves productivity and protects workers. In addition, AI has been extensively applied to mechanical manufacturing, greatly improving the efficiency of production and safety at work

II. TECHNICAL REVIEW

For many years, the necessity for research in AI has been motivated by two factors. The first of these is to give the new entrants into the AI field an understanding of the basic structure of the AI literature (Brooks (2001), Gamberger and Lavrac (2002), Kim (1995), Kim and Kim (1995), Patel-Schneider and Sebastiani (2003) and Zanuttini (2003)). As such, the literature discussed here answers the common query, "why must I study AI?"

The second factor is the upsurge of interest in AI that has prompted an increased interest and huge investments in AI facilities. AI research is all about sharing knowledge in order to further the field, so it's no surprise that people in the industry want to be aware of what their peers are working on. In fact, the desire to learn from each other is so strong that researchers have written articles about it. For example, Rosati (1999), Kaminka et al. (2002), Bod (2002), Acid and De Campos (2003), Walsh and Wellman (2003), Kambhampati (2000) and Barber (2000) have all published articles about the need for AI researchers to share knowledge.

AI research is a collaborative field, and we believe that by incorporating this information into our project, we can add value to the existing body of work by providing new ideas for researchers to continue pushing forward AI's frontier of knowledge. Artificial intelligence has been widely studied in the field of reasoning, and for good reason: reasoning is a key component to any solid AI system.

Researchers have focused on the following areas:

(i) axioms that give a complete axiomazation for the logic of reasoning;

(ii) theoretical properties of qualitative temporal reasoning algorithms;

(iii) what is relevant to a given problem of reasoning (independence);

(iv) methods for qualitative reasoning.

In 2000, Halpern also looked at causal reasoning in terms of axioms. Halpern defined causal models in terms of Pearl's equations, thus axiomatizing them.

Another study in 2000 by Tobies studied the complexity of combining the description logics ALCQ and ALCQI with terminological formalism based on cardinality restrictions on concepts. These combinations can be embedded into C2, which yields decidibility in next time. In the work of Cheng and Druzdzel (2000), an algorithm is developed for evidential reasoning in large Bayesian networks. The algorithm, called AISBN, is an adaptive importance sampling algorithm that shows promising convergence rates even under extreme conditions. It seems to outperform existing sampling algorithms consistently, and provides a better substitute to stochastic sampling algorithms, which have been observed to perform poorly in evidential reasoning with extremely unlikely evidence. In their paper, "Temporal Reasoning on Disjunctive Metric Constraints on Intervals and Time Points in Temporal Contexts," Singer et al. (2000) introduce the backbone fragility and the local search cost peak. The authors introduce a temporal model for reasoning on disjunctive metric constraints on intervals and time points in temporal contexts. This temporal model is composed of a labeled temporal algebra and its reasoning algorithms. The computational cost of reasoning algorithms is exponential in accordance with the underlying problem complexity, although some improvements were proposed.

The study of robots has been viewed from three dimensions: robot navigation, robot localisation, and robot participation in agent teams. A study conducted by Shatkay and Kaelbling (2002) focuses on robot navigation. The authors describe a formal framework for incorporating readily available odometric information and geometrical constraints into both the model and the algorithm that learns them. In a 2002 study, Stefanuk and Zhozhikashvili found that in the manufacturing field prominent research has been carried out in a number of areas, including quality monitoring and production scheduling. They carried out an analysis of the production and rules in the way they are used in AI systems. They proposed a new definition for productions that refers to a large number of types of production that may be found in the literature on AI systems. This definition emphasises in the most general way those production components that are important both for theory and for practice, which have been overlooked by many researchers. These components are supplemented in a theoretical formalism that concludes this paper.

III. ARTIFICIAL INTELLIGENCE AND THE MECHANICAL MANUFACTURE INDUSTRY

2.1. Definition and development of artificial intelligence

As a branch of computer science technology, artificial intelligence is the most representative technology in this field. Rather than waiting for human intelligence to develop, it aims to stimulate and improve our intelligence by learning from other related technologies such as virtual reality, Emulation techniques and speech recognition technologies.

The embryonic stage of artificial intelligence comprises the period in which computer technology was applied only in a few specific fields. At this stage, mechanical manufacturing was mainly manual. Not until electronic information technology began to emerge did people begin to gain access to networks at work and at home. During this phase of development, artificial intelligence gained recognition among the public and scientific interest blossomed. In 2012, deep neural network technology was applied in the field of image recognition. Since then, a large number of new neural networks have emerged. The application of deep learning algorithms has made a breakthrough in speech, image, and semantic recognition technology and many artificial intelligence innovations have come into being.

AI has developed through three stages: computational intelligence, perceptional intelligence and cognitive intelligence. At the computational stage, machines can process and convey information in a manner similar to humans. Perception intelligence allows machines to identify vision, speech, and language and take actions based on their judgments. Finally, cognitive intelligence allows machines to think and act like humans, notably in the areas of pilotless vehicles, autonomous robots, etc.

2.2 Development of mechanical manufacture industry

Around the world, mechanical manufacturing has gone through four stages of development. In the late 18th century, the Industrial Revolution —characterized by the invention of steam engines and machine tools— brought the manufacturing industry into the age in which machines replaced manual methods. From the beginning of the 1900s to the 1960s, the second industrial revolution happened, and manufacturing entered an era of electrification and automation; streamline and volume-production emerged. Based on the upgrading of industry 2.0, electric information technology was applied in the mechanical manufacturing industry, and today, micro-electronic technology, computer science and automation technology are widely used in manufacturing. Manufacturing is developing into integration. The fourth industrial revolution, which is integrating the internet, big data, cloud computing, the internet of things, and artificial intelligence into mechanical and electrical engineering manufacturing, began in the early 21st century.

IV. ADVANTAGES OF ARTIFICIAL INTELLIGENCE IN THE MANUFACTURING INDUSTRY

3.1. Effective and accurate information processing

Mechanical automation requires an electronic information transmission system to move information, but this system is subject to errors and has the potential to cause serious problems. To address this problem, artificial intelligence technology can be used with mechanical transmission systems to monitor for errors and for potential problems. This will result in more accurate processes for information transmission and will improve security in the entire system. Artificial intelligence technology can also be used to process information more effectively, which will improve both quality and efficiency in mechanical manufacturing.

4.2. Powerful data storage and calculation.

The most representative application of artificial intelligence technology in mechanical manufacture and automation is the neural network system. In fact, the system is an electronic information system built by imitating the human nervous system, and its main feature is its large amount of storage and the absolute accuracy of the data. Specifically, the neural network system analyses some data by simulating the structure of neurons and then uses the results of the analysis to obtain the participating values. From a structural point of view, neurons have very stable structures, making the whole neural network system more intelligent. Neural networks can be precise and accurate while processing huge amounts of data, so they are ideal for mechanical manufacturing and automation. Deep learning algorithms also offer new methods of controlling these systems.

V. APPLICATION OF ARTIFICIAL INTELLIGENCE IN MECHANICAL MANUFACTURE INDUSTRY

Artificial intelligence technology is increasingly being applied to mechanical manufacturing and automation. In manufacturing, artificial intelligence technology builds production models through computer simulation systems and makes comprehensive data analyses to make relevant precautious measures in case of emergency, which guarantees the orderly production system, reduces the possible capital loss of manufacturing enterprises, and also greatly improves the production efficiency and accuracy of manufacturing.

4.1. Fault diagnosis

A complex process of mechanical design, manufacturing and automation requires a large amount of data calculation. One particularly heavy-duty task is formulating and validating the effectiveness of potential solutions to engineering problems. Manually conducting this task is time-consuming and rife with human error, but utilizing artificial intelligence can make the process more accurate and efficient.

Further, artificial intelligence can also be used to diagnose the mechanical failure. In a method of fault diagnosis based on expert system theory, data being monitored by machines are input into the system through a human-machine interface. The reasoning machine then provides corresponding diagnostic results through a forward inference engine and presents expert opinions. Finally, most similar cases in history are obtained by intelligent searching, and similarity is calculated based on historical cases to diagnose mechanical faults.

One of the advantages of AI technology is its ability to be used in the predictive maintenance of equipment. Predictive maintenance involves collecting the actual operation data of a machine and comparing it with an intelligent training model. When a problem is detected, AI enables systems to warn and remind personnel who are responsible for maintaining the machine to take action. In this way, the technology improves not only a plant's safety but also its efficiency.

5.2. Quality inspection

Comparisons between different people, depending on differences in physical or mental state, results in inconsistencies in inspection standards. Rapid mass production inspections are especially difficult for manual detection to complete. However, artificial intelligence detection that uses deep learning machine Vision technology can provide more unified, stable and faster quality inspections.

5.3. Improving the safety of working places

Safety has been a significant issue in traditional manufacturing due to the high frequency of unsafe problems in the manufacturing process. Thanks to AI, these problems can be avoided to the greatest degree. AI can recognize the safety status of working places with its unique cognitive function, it will warn workers to leave the spot or take other necessary actions in case of emergency. Moreover, AI systems can also monitor and control worker access based on facial recognition. With image recognition technology, digital assistants can assess whether workers are wearing necessary safety equipment, such as safety helmets and goggles. Thus, the safety situation in manufacturing will be much improved with the help of digital assistants.

In addition to the aspects above, artificial intelligence can also assist in product development, manufacturing and repair services. Requiring only a small amount of time for its data storage, artificial intelligence allows its clients to easily find their desired products and thus shorten the time needed to design products. Similarly, during the manufacturing process, artificial intelligence can help products be created with the highest accuracy by streamlining the entire process. In addition to this, artificial intelligence can also provide far-distance equipment maintenance when necessary. This includes spare parts management, routine or predictive maintenance issues, fault warnings and diagnoses, product upgrades and more.

VI. CONCLUSION

With the rapid development of science and technology, there are great changes in people's lives due to progressive social production. Due to the fast pace of life and the coming of the 4.0 industrial revolution, artificial intelligence has gained popularity and is being applied widely to mechanical manufacturing and automation. Its powerful data storage and computation and its effective and precise information processing bring great benefits to the manufacturing field. It is helpful to promote work efficiency and quality control, spare more valuable work for human beings to do, provide much safer working places, diagnose faults and offer predictive maintenance, and develop more intelligent supply chains as well. On one hand, mechanization and automation provide a platform for research into artificial intelligence. However, no matter how fast technology develops and how many changes occur in manufacturing, people will always be integral to the field.

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