Proceedings of the 2023 International Conference on Machine Learning and Automation
DOI: 10.54254/2755-2721/38/20230528

An analysis of the applications of mechatronics in intelligent manufacturing

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Abstract. With the continuous development of the social economy, countries increasingly pay more attention to mechatronics and put forward various relevant policies for the actual situation of mechatronics to promote mechatronics and achieve sustainable development. However, from the current actual situation of mechatronics, due to the influence of various external factors, its degree of development cannot meet the requirements of modern social development; therefore, the application of advanced intelligent technology to mechatronics design is inevitable. Based on this, this paper expounds the intelligent manufacturing technology and mechatronics system overview as the basis for analysing the actual situation of the development of modern mechanical and electrical equipment digital design, then analyses the advantages of intelligent technology from different aspects and applies them to the daily mechatronics design to bring huge economic benefits to enterprises, and concludes that the development level of social productivity in the future is closely related to the integration level of mechatronics and intelligent manufacturing.

Keywords: Mechatronics, Intelligent Manufacture, Operation Mode.

1. Introduction

Mechatronics, also known as mechatronics, has gradually become widely used in production with the progress of science and technology and the rapid development of the economy. Especially in today's fierce competition in the market economy, mechatronics technology has become a strong driving force for industrial production [1]. Thus, to realise the intelligent management of machinery and equipment, the manufacturing of the new century must be intelligent manufacturing. Intelligent manufacturing contains two meanings: intelligent manufacturing system and intelligent manufacturing technology. In the current production process of industrial enterprises, intelligent manufacturing has become the mainstream of manufacturing. Intelligent manufacturing analyses and rationalizes all aspects of the manufacturing process through computer simulations of the human brain. For example, Xiang Fan analysed this topic through the analysis of examples and finally found that the auxiliary role of intelligent manufacturing is inseparable from mechatronics [1]. In this paper, the application of mechatronics in intelligent manufacturing and the contribution of intelligent manufacturing to mechatronics are studied. Through theoretical analysis and case study, the conclusion is drawn that the common development of the two is an inevitable requirement of the development of the new era. Its significance is to explain the existing research situation so as to find the development trend between the two in the future. It is of great help in reducing the loss of resources and improving the efficiency of social production.

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2. Overview of mechatronics technology

Mechatronics is defined as "the synergetic integration of mechanical engineering with electronic and intelligent computer control in the design and manufacturing of industrial products and processes". Different areas are included in it, such as intelligent control and manufacturing [2]. It is a practice-based technology unlike any other. Intelligent manufacturing is closely related to mechatronics, but in general mechatronics is the most basic and fundamental. There are various theories about mechatronics, but mechatronics is essentially a product-based technology, so in most cases we need real working hardware to convince people. In a sense, mechatronics is seen as a post-competitive technology. When it comes to mechatronics, it's important to understand the problem at hand and the mechatronics resources available, such as sensing, drive, and computing power. It is also necessary to analyze the system from the beginning for a better design and control solution, balancing hardware and software for cost effectiveness. System design and evaluation is not a one-time process, but an iterative process. While learning from the successful experience of predecessors, we should also think rationally and explore new methods.

3. Function of intelligent manufacturing in mechatronics

3.1. Intelligent manufacturing application background

In modern society, production technology has been updated in order to comply with the trend of the times. Mechatronics and intelligent manufacturing technology are also constantly innovating; the two cooperate with each other, and new technical means and production equipment together constitute a modern production mode. In order to reduce the cost of labour and material resources while meeting the needs of a growing society, mechatronics production is the trend of the times. It can effectively improve economic benefits, and intelligent manufacturing, because of its characteristics, can improve efficiency and reduce resource loss. As the proportion of intelligent manufacturing in mechatronics increases, the need for intelligent manufacturing technology needs to be used in mechatronics production [3].

3.2. Function of intelligent manufacturing in mechatronics

3.2.1. Improving the Safety Level of Modern Production. In the process of production, it is inevitable that the safety risks of chemical products will increase. Some chemical products have a certain corrosive quality and may even harm the safety of the human body. This is one of the most important problems in modern production, so factories all over the world are eager to enhance the safety level through some means to avoid these security risks.Therefore, through the application of mechatronics production technology and advanced production equipment, it is possible to create a very safe chemical production environment, and reduce the safety production risk by 30% to 55% [4].

3.2.2. Strengthening mechanical and electrical equipment automation control performance. Compared with manual technology, intelligent automation processing methods have diversified characteristics, such as simple operation, high efficiency, low cost, and high safety. They can control the working time of mechatronics, reduce the working capacity of staff, avoid the influence of various external factors, further improve the entire operation process, and solve the problems existing in production through remote operation. As a result, they can strengthen the safety of birth equipment [1]. The staff should comprehensively analyze the problems existing in the operation of the automatic system of mechanical and electrical equipment, establish a data information model according to the actual situation, predict the cause and specific location of the accident in advance, avoid the problem of stopping production which will have a serious impact on production efficiency, and reasonably control production losses

3.2.3. Reducing the automation error rate of electromechanical equipment. When analyzing the operation data of the mechanical automation system, it is necessary to analyze the different aspects to ensure that the operation efficiency of the system reaches the expected level. At the same time, in view

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of the high error rate in the system, it is necessary to rationally use intelligent technology for processing, improve real-time data and information, scientifically control the operation of equipment, and effectively ensure the accuracy of technical personnel when consulting. With the deepening of the application of intelligent technology, the mechanical and electrical integration automation control effect is infinitely close to the expected effect, can effectively reduce the work intensity of staff and equipment maintenance costs, solve the problems existing in traditional mechanisation management, use a reasonable way to choose the best control measures, effectively control the production cost of staff, and improve the core competitiveness of enterprises. The use of intelligent control technology can skip the model design link, avoid problems that can not be evaluated, improve the mechanical and electrical integration automation control effect, and at the same time, under the influence of the complexity of the mechanical control system, this equipment analysis and processing method can diagnose equipment faults, improve the production efficiency of the electronic control system, promote the development of mechanical technology, and provide rich data resources.

3.3. Case analysis

3.3.1. The control system of IMS4. Compared with traditional computer integrated manufacturing (CIM), intelligent manufacturing systems (IMS) are more flexible and intelligent.IMS is adaptable, which means integrated equipment, processes and systems that can be reconfigured at any time;In addition, it can reduce waste and energy consumption in the process, and use technologies to convert information into knowledge for effective decision making, to address a wide range of product requirements.Multi-agent systems can provide distributed intelligent control actions to create the evolvable systems needed for flexible and distributed manufacturing systems that are already needed in our time and are critical for the future [5].

3.3.2. Construction of intelligent manufacturing platform for electromechanical equipment. Agricultural machinery generation intelligent factories will combine digital manufacturing and intelligent factories in the combination process to create intelligent equipment and three-dimensional simulation as the core to realise the intelligent manufacturing process. At present, the entire intelligent process mainly includes digital simulation, intelligent manufacturing process management, optimization of digital workshops and parts virtual simulation and other links, and staff can master the business scope of intelligent manufacturing by analyzing two-dimensional data. In the operation process of the digital factory, the enterprise layer, the equipment layer, the workshop layer and other links should give full play to their own use, apply intelligent manufacturing technology to the daily production process and design links, and build a sound three-dimensional model to realize the combination of intelligent manufacturing and digital design. For example, when designing aircraft in the United States, it makes reasonable use of digital technology to produce paperless, effectively shortening the research cycle by 2/3, and controlling the production cost within a reasonable range [6].

Simulation is an important method of intelligent manufacturing. Staff need to take virtual simulation technology as the main body, including real simulation of mechanical parts and virtual assembly, simulation of the entire processing manufacturing and parts design link, and master the whole process of parts from material procurement to production and processing link. 1. Machining simulation. This link can analyze the accuracy of the processing path, check whether there is a workpiece and tool collision problem, strengthen the rationality of the cutting margin, and help the staff to master the entire processing process. 2. Assembly simulation. The problems in the parts were found by assembling the imitation parts, and the parts model was established by dynamic simulation and kinematic simulation. 3. Logistics simulation. The loop section truly simulates logistics operation content, such as path planning efficiency, logistics facility capacity, etc., to improve the rationality of production processes. 4. Engineering layout simulation, such as warehousing and logistics facility planning, new plant planning, and production line planning. The real simulation by the simulation model is conducive to finding the problems in the design and guiding the processing and design process to the digital direction.

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Through the real simulation of a supply system project, the construction period of the factory can be effectively shortened and the design cost can be controlled within a reasonable range. At the same time, through intelligent manufacturing technology, the staff can establish a big data cloud platform and a digital platform for intelligent manufacturing of mechanical and electrical equipment to develop various application platforms, such as intelligent products, intelligent materials, intelligent factories and other platforms, store various virtual simulation data and save the virtual simulation process. In addition, smart IoT technology is used to set up sensor devices and automate the operation of mobile devices and actuators through control systems, thus enabling intelligent manufacturing processes.

4. Application of mechatronics technology in intelligent manufacturing

4.1. Application of CAD/CAPP/CAM information integration in intelligent manufacturing

In a CAD, CAM, or CAPP information integration system, the role is to combine different processing centres and intelligent computing control systems in intelligent manufacturing so that ten parts can work together in order to achieve intelligent management of mechanical production and processing, real-time processing data, and the production of corresponding products. At the same time, collaborative management under the background of intelligent control can integrate different intelligent technologies to establish an intelligent machining management system that has functions such as programme design, numerical control programming, modelling design and processing simulation, reasonable application of various data in the engineering database, preparation of data for automatic design and processing schemes, fully reflect various functions in intelligent manufacturing,and eventually form an automatic control production line.

4.2. Application of numerical control technology in intelligent manufacturing

Automatic control of machining equipment through PLC control programming technology can be combined with its actual situation to set program control commands to strengthen the rationality of production assignment [7]. When it meets the expected conditions, the equipment instructions are automatically activated to control the orderly development of the machine. At the same time, in the intelligent manufacturing process, the computer is used to send instructions to the production machine equipment, the machine will complete the entire production operation according to the instruction content, and the production information is transmitted to the computer, which is conducive to the comprehensive detection of daily production data and reasonable adjustment of production information. In intelligent manufacturing, the programmable control system should be scientifically applied to allow the machines and equipment storing data to further analyze the production parts, and at the same time, the wired network and the wireless network should be combined in the processing to realize the remote control of machine production [8]. In addition, the staff can control the machine and equipment through digital control technology and computer control technology, improve the stability of the entire production process, use the computer system to issue production orders to the machine control system, and then use the machine control system and human-computer interaction system to complete automated production control, and promote the development of the mechatronics production process to the intelligent direction.

4.3. Application of intelligent robot technology in intelligent manufacturing

Intelligent robots are an important product of mechatronics automation, which promotes the development of mechatronics equipment in an intelligent direction and can effectively solve the problem of insufficient brainpower and intelligence among traditional workers, which is highly valued by relevant enterprises. By applying intelligent robots to daily manufacturing work, it can automatically determine whether the production process meets the requirements of later use, which can not only reduce the production cost of industrial manufacturing, but also improve the efficiency of mechanical processing, and replace the staff to carry out various dangerous work. Make use of diversified technologies to create intelligent robots that simulate human operation, such as automatic control

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technology, intelligent control modules, mechatronics technology, etc.[9] In response to this situation, the staff should pay more attention to mechatronics technology, combine mechatronics technology with intelligent manufacturing, realize intelligent robot simulation control, and use intelligent control technology to simulate human thinking logic so that manufacturing robots and personnel have the same judgement ability [10]. After the staff issued relevant instructions, the robot completely simulates the various actions of humans for processing, effectively improving the level of intelligent manufacturing technology in mechanical processing.

5. Conclusion

From the above analysis, it can be concluded that intelligent manufacturing technology for mechatronics production is of great help; similarly, intelligent manufacturing also needs mechatronics to provide a platform and foundation for it; the two complement each other. In summary, in a modern society with rapid development, improving intelligent manufacturing technology is a necessary choice for enterprises to continuously strengthen their competitiveness, and mechatronics technology can deal with problems in the production process, reduce costs, improve efficiency, and improve efficiency. Therefore, it is the general trend to realize the integration of the two technologies as soon as possible, which can reduce the loss of resources and maximize their use. At the same time, it can continuously reduce the production cost and improve the work efficiency of production equipment, so as to realize the effectiveness of technology integration and the high economic benefits of enterprises. The shortcoming of the current paper is that the actual knowledge of the application of these two technologies is still insufficient, and future research needs to focus on the practice and experimentation of the joint effect of the two.

Acknowledgment

Firstly, I would like to show my deepest gratitude to my teachers and professors in my university, who have provided me with valuable guidance in every stage of the writing of this thesis. Further, I would like to thank all my friends and parents for their encouragement and support. Without all their enlightening instructions and impressive kindness, I could not have completed my thesis.

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