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ШТУЧНИЙ ІНТЕЛЕКТ В ГАЛУЗЕВОМУ МАШИНОБУДУВАННІ: СУЧАСНІ ТЕНДЕНЦІЇ ТА ПЕРСПЕКТИВИ

У статті представлено комплексний аналіз сучасних тенденцій та перспектив застосування штучного інтелекту в галузевому машинобудуванні. Розглянуто ключові напрямки інтеграції штучного інтелекту, такі як оптимізація виробничих процесів через машинне навчання та глибоке навчання, прогнозування відмов обладнання з використанням аналізу великих даних та алгоритмів штучного інтелекту, розробка нових матеріалів шляхом моделювання та симуляцій на основі штучного інтелекту, а також автоматизація проєктування за допомогою генеративних моделей та систем автоматизованого проєктування (CAD) з інтегрованим штучним інтелектом. Досліджено переваги та недоліки впровадження штучного інтелекту, включаючи підвищення ефективності виробництва, зниження витрат, покращення якості продукції, скорочення часу розробки та підвищення безпеки праці, а також виклики, пов'язані з високою вартістю впровадження, необхідністю навчання персоналу та ризиком втрати робочих місць. Особлива увага приділена перспективам розвитку штучного інтелекту в галузі, включаючи створення повністю автоматизованих виробничих ліній, розробку самонавчальних систем управління виробництвом, створення інтелектуальних роботів та розробку нових матеріалів з використанням штучного інтелекту. Стаття також розглядає етичні та соціальні аспекти впровадження штучного інтелекту, такі як вплив на ринок праці та необхідність розробки відповідних нормативних актів. У статті розглядаються застосування штучного інтелекту в галузевому машинобудуванні. Аналізуються основні напрямки використання, такі як проєктування, оптимізація, керування виробничими процесами, діагностика та прогнозування стану обладнання. Розглядаються переваги та виклики впровадження в машинобудівних підприємствах, а також перспективи подальшого розвитку цієї технології в галузі.

Ключові слова Штучний інтелект, машинобудування, автоматизація, оптимізація, прогнозування, матеріали.

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ARTIFICIAL INTELLIGENCE IN THE ENGINEERING INDUSTRY: CURRENT TRENDS AND PROSPECTS

The article presents a comprehensive analysis of current trends and prospects for the application of artificial intelligence in industrial mechanical engineering. The key areas of artificial intelligence integration are considered, such as optimization of production processes through machine learning and deep learning, forecasting equipment failures using big data analysis and artificial intelligence algorithms, development of new materials through modeling and simulations based on artificial intelligence, as well as design automation using generative models and computer-aided design (CAD) systems with integrated artificial intelligence. The advantages and disadvantages of implementing artificial intelligence are explored, including increasing production efficiency, reducing costs, improving product quality, reducing development time, and increasing occupational safety, as well as challenges associated with the high cost of implementation, the need for staff training, and the risk of job losses. Particular attention is paid to the prospects for the development of artificial intelligence in the industry, including the creation of fully automated production lines, the development of self-learning production management systems, the creation of intelligent robots, and the development of new materials using artificial intelligence. The article also considers the ethical and social aspects of the implementation of artificial intelligence, such as the impact on the labor market and the need to develop appropriate regulations. The article examines the application of artificial intelligence in industrial mechanical engineering. The main areas of use are analyzed, such as design, optimization, production process control, diagnostics and forecasting of equipment condition. The advantages and challenges of implementation in mechanical engineering enterprises, as well as the prospects for further development of this technology in the industry, are considered.

Keywords Artificial intelligence, mechanical engineering, automation, optimization, forecasting, materials.

Intro.

The mechanical engineering industry, as a fundamental component of the industrial sector, is on the verge of significant transformations driven by the rapid development of artificial intelligence technologies. This industry, traditionally characterized by complex production processes, high precision requirements and ever-increasing pressure to optimize costs, opens up wide opportunities for the integration of artificial intelligence. Modern challenges facing the mechanical engineering industry include the need to increase productivity, reduce the time to develop new products, ensure high product quality, and minimize the risks associated with equipment failures. In this context, artificial intelligence acts as a powerful tool that can radically change the approaches to the design, production, and operation of equipment. The integration of artificial intelligence into mechanical engineering not only helps automate routine tasks, but also opens up new horizons for innovation [1]. Machine learning and deep learning algorithms allow you to analyze huge amounts of data, identify patterns, and predict the behavior of complex systems. This makes it possible to optimize production processes, predict equipment failures, develop new materials with improved characteristics, and automate design.

Object and methods of research.

The object of research is the processes of industrial mechanical engineering in which artificial intelligence is used. Research methods include analysis of scientific literature and industrial reports, conducting experiments and modeling, studying examples of successful application of artificial intelligence in industrial mechanical engineering. The use of artificial intelligence in industrial mechanical engineering has great potential for increasing the efficiency and competitiveness of enterprises.

Task statement. In this article, we will consider current trends and prospects for the application of artificial intelligence in industrial mechanical engineering, focusing on key areas such as optimization of production processes, prediction of equipment failures, development of new materials, and design automation. We will also analyze the advantages and disadvantages of implementing artificial intelligence, as well as its potential impact on the future of the industry. Artificial intelligence can be used to optimize production processes and at various stages, including production planning, can analyze data on orders, resources, and production capacity to optimize production planning, minimize downtime, and increase efficiency. Quality control, can be used to automatically control product quality, detect defects, and predict equipment failures. Logistics management - can optimize logistics processes, reducing delivery times and reducing costs. In the context of industrial mechanical engineering, where the complexity and dynamism of production processes reach a high level, optimization becomes a key factor of competitiveness. Artificial intelligence offers a wide range of tools and methods for intellectualizing and automating production, allowing for significant efficiency gains and cost reductions. Intelligent production planning and management: demand forecasting and inventory optimization - machine learning algorithms can analyze historical sales data, market trends, and other factors to accurately forecast product demand.

This allows you to optimize inventory levels, minimizing storage costs and preventing shortages. Production scheduling and resource allocation - artificial intelligence can develop optimal production schedules, taking into account resource constraints, order fulfillment times and other factors. This allows you to maximize equipment utilization, reduce order fulfillment times, and increase productivity. Adaptive production process management - artificial intelligence systems can in real time analyze data from sensors and other sources to detect deviations from planned production parameters and automatically adjust processes. This allows you to minimize waste and improve product quality. Intelligent quality control automatic defect detection - computer vision systems based on artificial intelligence can automatically detect defects in products using cameras and other sensors. This allows for increased accuracy and speed of quality control, as well as reduced manual inspection costs. Equipment Failure Prediction - Machine learning algorithms can analyze data from sensors to predict equipment failures, allowing for preventive maintenance and accident prevention. Optimization of process parameters for quality assurance - artificial intelligence can analyze data on process parameters and product quality to identify optimal parameter values that ensure high product quality. Intelligent logistics and supply chains -artificial intelligence algorithms can develop optimal delivery routes, taking into account distances, delivery times, fuel costs and other factors. This allows for shorter delivery times and lower logistics costs. Delay and risk prediction - can analyze supply chain data to predict delays and risks, allowing for early action to prevent them. Warehouse management automation - systems can automate warehouse management, including receiving, storing, and shipping goods. This allows you to reduce order processing time and minimize errors. Robotics and automation. Intelligent robots - robots equipped with artificial intelligence systems can perform complex tasks such as welding, assembly and processing of parts. This allows you to increase productivity and quality of production, as well as reduce the cost of manual labor. Automated production line systems can control automated production lines, optimizing process parameters and ensuring smooth operation [2].

Results and discussion. The introduction of artificial intelligence into the optimization of production processes is a key factor in increasing the competitiveness of the industrial mechanical engineering industry. This allows for significant increases in efficiency, cost reduction, and product quality improvement. The introduction of artificial intelligence into industrial mechanical engineering opens up a wide range of advantages that contribute to the transformation of production processes, increasing efficiency and strengthening the competitiveness of enterprises, in particular, increasing production efficiency, reducing costs, improving product quality, shortening the time for developing new products, improving occupational safety. The introduction of artificial intelligence into industrial mechanical engineering is a strategically important step for increasing the competitiveness of enterprises. This allows for significant efficiency gains, cost reductions, improved product quality, reduced time to develop new products, and increased safety. Despite the significant benefits, the implementation of artificial intelligence in industrial engineering is accompanied by a number of disadvantages and challenges that must be taken into account for the successful integration of this technology. These are the high cost of implementation,

the need for staff training, the risk of job losses, data dependence, ethical and legal issues. Given these shortcomings and challenges, enterprises need to carefully plan and implement the implementation of artificial intelligence, ensuring proper staff training, data protection, and compliance with ethical and legal norms. The implementation of artificial intelligence in industrial engineering is a promising direction of development that can lead to significant changes in the industry. It is expected that in the future it will be used to create fully automated production lines, develop self-learning production management systems, create intelligent robots capable of performing complex tasks, and develop new materials using artificial intelligence.

Conclusions. In summary, the introduction of artificial intelligence into industrial mechanical engineering opens up unprecedented opportunities for transforming production processes, increasing efficiency, and strengthening the competitiveness of enterprises. The study showed that artificial intelligence can be successfully applied to optimize production, predict equipment failures, develop new materials, and automate design. Intelligent production planning and management, automatic quality control, logistics optimization and process robotization allow for significant productivity increases, cost reductions and improved product quality. In addition, AI helps reduce the time to develop new products and improve occupational safety. However, its implementation is also accompanied by a number of challenges, such as high cost, the need for staff training, the risk of job losses, data dependence and ethical issues. For successful integration, it is necessary to carefully plan and implement this process, ensuring proper staff training, data protection, and compliance with ethical and legal norms. The prospects for the development of artificial intelligence in industrial mechanical engineering are extremely broad. It is expected that in the future, artificial intelligence will be used to create fully automated production lines, develop self-learning production control systems, create intelligent robots, and develop new materials using it.

To realize this potential, it is necessary to invest in research and development. Development of new artificial intelligence algorithms and their adaptation to the needs of industrial mechanical engineering, create a favorable regulatory environment, develop regulations that regulate the use of artificial intelligence in industry, ensuring safety and ethics. To prepare personnel, namely to develop training programs for training specialists in artificial intelligence for the industrial mechanical engineering sector. To establish cooperation between enterprises, scientific institutions and government bodies to exchange knowledge and experience. The introduction of artificial intelligence into the industrial mechanical engineering industry is an inevitable process that will change the landscape of the industry. Companies that can successfully integrate it will gain significant competitive advantages and be able to effectively respond to the challenges of the modern market.

Literature

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