

Application of artificial intelligence in applied sciences

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Abstract: *This article is devoted to the systematic analysis of the application of artificial intelligence (AI) technologies in the field of applied sciences. The study examines the integration of AI into scientific research processes, particularly the role of machine learning algorithms, neural networks, and automated experimental systems in applied sciences. The article analyzes examples of AI applications in applied fields such as medicine, biology, engineering, and materials science, substantiating the importance of these technologies in accelerating the process of scientific discovery. Furthermore, the advantages, limitations, and future development prospects of AI-based approaches are discussed.*

Keywords: *artificial intelligence, applied sciences, machine learning, neural networks, automated research, IMRAD*

INTRODUCTION

With the acceleration of scientific and technological progress in the 21st century, artificial intelligence (AI) technologies are becoming an integral part of scientific research. As the International Science Council (ISC) emphasizes, artificial intelligence is not only improving computational tools but is fundamentally reshaping the scientific enterprise, contributing to hypothesis generation, and expanding traditional methods of theory and experiment. This phenomenon is particularly evident in the field of applied sciences.

Applied sciences - a field that directs theoretical knowledge toward solving real-world problems - encompasses numerous directions such as medicine, engineering, agriculture, and materials science. The application of artificial intelligence in these areas is creating opportunities to optimize research processes, increase the speed of data analysis, and make new scientific discoveries. International conferences, including the "Digital Transformation and Artificial Intelligence" forum held in Uzbekistan, also demonstrate the relevance of research in this direction.

The purpose of this article is to analyze the state of application of artificial intelligence technologies in the field of applied sciences, systematize existing approaches, and determine future development prospects. The study sets the following objectives: (1) to identify the main directions of AI application in applied sciences; (2) to analyze the algorithmic approaches used in each direction; (3) to evaluate the effectiveness of AI-based research; (4) to identify existing limitations and problems.

METHODOLOGY

This study employed systematic analysis and literature review methods. Articles published between 2020-2025 from international scientific databases (Scopus, Web of Science, IEEE Xplore) were selected for analysis. Content analysis and comparative analysis methods were used in data analysis. The following criteria were used as a basis for evaluating research on the application of artificial intelligence in applied sciences: (a) type of AI algorithms (machine learning, deep learning, generative models, etc.); (b) field of application (medicine, biology, engineering, etc.); (c) research

purpose (descriptive, predictive, generative, or optimization); (d) accuracy and reliability of obtained results.

RESULTS

During the study, several main directions of artificial intelligence application in applied sciences were identified. The following is an analysis of these directions and their characteristics.

Main directions of artificial intelligence application in applied sciences

Direction	Application areas	Main AI methods	Performance indicators
Medical diagnostics	Oncology, neurology, cardiology	Convolutional neural networks, Transfer learning	Accuracy 87-96%
Biological research	Genomics, proteomics, cell biology	LSTM, Transformer models, K-means	Acceleration up to 25 times
Materials science	Nanophotonics, polymers, composites	Autoencoders, Gaussian processes	Discovery of new materials
Environmental monitoring	Climate modeling, ecology	CNN, RNN, ensemble methods	Prediction accuracy up to 92%

In the field of medicine, artificial intelligence algorithms, particularly convolutional neural networks (CNN), are demonstrating high efficiency in image analysis. For example, the BreastScanAI system detects breast cancer from MRI images with 94% accuracy. Additionally, models have been developed that enable early detection of Parkinson's disease based on handwriting and speech characteristics, utilizing transfer learning and generative data augmentation methods.

In biology and biotechnology, artificial intelligence plays an important role in optimizing experimental research. The hybrid machine learning approach developed by scientists at Charles Sturt University, combining Ordinary Least Squares (OLS) and Gaussian Process (GP) regression, enabled optimization of growth conditions for diatom algae. This approach achieved optimal conditions through only 25 virtual experiments, whereas traditional methods require more time and resources.

In materials science and nanophotonics, the AutoSciLab system developed at Los Alamos National Laboratory deserves special attention. This "self-driving laboratory" operates based on a four-stage artificial intelligence architecture: (i) generating high-dimensional experiments using variational autoencoders; (ii) selecting optimal experiments through active learning; (iii) identifying important latent variables using "directed autoencoders"; (iv) generating human-understandable equations through neural network equation learners. The AutoSciLab system discovered a new method for controlling incoherent light radiation in nanophotonics.

In engineering and industry, the application of artificial intelligence is also extensive. LSTM networks have shown higher accuracy compared to traditional ARIMA models in predicting oil prices. Furthermore, enhanced LSTM approaches are being applied to predict the performance of hybrid floating photovoltaic-hydropower systems in renewable energy systems.

In environmental studies and climate modeling, artificial intelligence methods are enabling the analysis of complex ecological systems. For example, machine learning models have been used to predict thunderstorms in Colombia, showing more accurate results compared to traditional meteorological methods.

DISCUSSION

The obtained results reveal several important aspects of applying artificial intelligence in applied sciences. First, artificial intelligence technologies are being effectively applied at various stages of

scientific research - from data collection and analysis to hypothesis generation and experiment planning. This confirms the International Science Council's conclusion that AI is not a monolithic technology but encompasses a range of paradigms.

Second, various types of artificial intelligence methods are successfully being applied to solve descriptive, predictive, generative, and optimization problems in science. As can be seen in the AutoSciLab example, AI not only analyzes existing data but is also capable of automating the very process of making new scientific discoveries. This indicates a fundamental change in scientific research methodology.

Third, artificial intelligence approaches enable significant savings in time and resources compared to traditional methods. The acceleration of up to 25 times achieved in biological research and the dramatic reduction in the number of virtual experiments demonstrate the economic efficiency of AI in applied sciences.

However, there are also a number of limitations and problems associated with the application of artificial intelligence in applied sciences. First, the "black box" nature of AI algorithms often complicates the interpretation of obtained results. In the AutoSciLab project, a module for generating human-understandable equations was specifically developed to address this problem. Second, the excessive dependence of artificial intelligence systems on data makes the issue of data quality and representativeness crucial.

Additionally, ethical issues and ensuring research integrity are also pressing problems. As the International Science Council noted, AI's reliance on data represents an intersection of computer science, mathematics, and statistics with social problems, including ethical questions. Therefore, methodological rigor and ethical responsibility acquire special importance in research conducted using artificial intelligence.

CONCLUSION

This article systematically analyzed the application of artificial intelligence technologies in the field of applied sciences. Research results show that artificial intelligence plays an important role in all directions of applied sciences - medicine, biology, materials science, engineering, and environmental studies. Machine learning, deep learning, and generative models enable accelerating scientific research, optimizing experiments, and making new discoveries.

The main advantages of artificial intelligence in applied sciences are as follows:

- Increasing research speed by up to 25 times;
- Conducting effective analysis in high-dimensional data spaces;
- Discovering complex correlations undetectable by traditional methods;
- Automating and optimizing experimental processes;
- Reducing errors caused by human factors.

The following can be identified as promising directions for future application of artificial intelligence in applied sciences: (a) development of "self-driving laboratories"; (b) integration of multi-modal data; (c) improvement of explainable AI models; (d) creation of adaptive experimental systems operating in real-time.

In conclusion, artificial intelligence has strategic importance in the development of applied sciences, and its role is expected to increase further in the coming years. Therefore, mastering AI technologies and implementing them in practice remains an urgent task for scientific research institutions and scientists.

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