



UDC: 81'322.2:004.89:316.42

[https://doi.org/10.52058/2786-6165-2026-3\(45\)-129-142](https://doi.org/10.52058/2786-6165-2026-3(45)-129-142)

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HYBRID AI IN CONTEMPORARY MACHINE LINGUISTICS IN CONTEXT OF GLOBAL PHILOLOGICAL TRENDS

Abstract. Purpose. The purpose of this article is to analyze the features of using hybrid artificial intelligence in philology and linguistics, and to determine its functional role in the context of modern global philological trends. The study aims to research the integration of computational methods with traditional linguistic approaches to identify promising areas for the development of hybrid intelligent technologies.

Methodology. The research is based on the interdisciplinary synthesis of humanitarian, mathematical, and technical approaches. The analysis focuses on hybrid artificial intelligence models that combine machine learning, neural networks, and symbolic programming with formalized linguistic rules. This approach allows for overcoming the limitations of purely statistical or neural network models by providing a more comprehensive understanding of semantic and cultural text characteristics.

Results. The study identifies that the current stage of philology is characterized by an intensive digital transformation and the formation of "Digital Philology".

Hybrid intelligent systems are actively used for Natural Language Processing (NLP), automated discourse analysis, and the study of intercultural communication.

It is established that combining deep neural networks with formalized grammatical rules is crucial for processing languages with complex morpho-



logical systems. Such systems facilitate high-quality automated translation and the identification of hidden semantic structures in large-scale text arrays.

Conclusions. The introduction of hybrid AI forms a qualitatively new paradigm in philology, transforming it from a predominantly interpretive discipline into a field that actively utilizes computational data analysis. The integration of these technologies significantly expands the methodological tools of linguistics and increases the efficiency of analyzing complex language structures. Future research prospects are linked to the development of intelligent systems capable of capturing complex pragmatic and cultural aspects of social communication.

Keywords: Philology, Computational Linguistics, Hybrid Artificial Intelligence, Natural Language Processing, Digital Humanities, Neural Networks, Corpus Linguistics, Machine Translation, Intercultural Communication

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ГІБРИДНИЙ ШТУЧНИЙ ІНТЕЛЕКТ У СУЧАСНІЙ МАШИННІЙ ЛІНГВІСТИЦІ У КОНТЕКСТІ ГЛОБАЛЬНИХ ФІЛОЛОГІЧНИХ ТЕНДЕНЦІЙ

Анотація. Мета. Метою цієї статті є аналіз особливостей використання гібридного штучного інтелекту у філології та лінгвістиці, а також визначення його функціональної ролі в контексті сучасних світових філологічних тенденцій. Метою дослідження є дослідження інтеграції обчислювальних методів з традиційними лінгвістичними підходами для визначення перспективних напрямків розвитку гібридних інтелектуальних технологій.

Методологія. Дослідження базується на міждисциплінарному синтезі гуманітарних, математичних та технічних підходів. Аналіз зосереджений на гібридних моделях штучного інтелекту, які поєднують машинне навчання, нейронні мережі та символічне програмування з формалізованими



лінгвістичними правилами. Такий підхід дозволяє подолати обмеження суто статистичних або нейромережових моделей, забезпечуючи більш повне розуміння семантичних та культурних характеристик тексту.

Результати. У дослідженні визначено, що сучасний етап філології характеризується інтенсивною цифровою трансформацією та формуванням «цифрової філології». Гібридні інтелектуальні системи активно використовуються для обробки природної мови (NLP), автоматизованого аналізу дискурсу та вивчення міжкультурної комунікації. Встановлено, що поєднання глибоких нейронних мереж з формалізованими граматичними правилами має вирішальне значення для обробки мов зі складними морфологічними системами. Такі системи сприяють високоякісному автоматизованому перекладу та виявленню прихованих семантичних структур у великомасштабних текстових масивах.

Висновки. Впровадження гібридного штучного інтелекту формує якісно нову парадигму у філології, перетворюючи її з переважно інтерпретаційної дисципліни на галузь, яка активно використовує обчислювальний аналіз даних. Інтеграція цих технологій значно розширює методологічний інструментарій лінгвістики та підвищує ефективність аналізу складних мовних структур. Майбутні перспективи досліджень пов'язані з розробкою інтелектуальних систем, здатних вловлювати складні прагматичні та культурні аспекти соціальної комунікації.

Ключові слова: філологія, комп'ютерна лінгвістика, гібридний штучний інтелект, обробка природної мови, цифрові гуманітарні науки, нейронні мережі, корпусна лінгвістика, машинний переклад, міжкультурна комунікація

INTRODUCTION

In the context of the dynamic development of digital technologies and the strengthening of the processes of globalization of scientific knowledge, philology and linguistics are at the stage of significant transformations caused by the active introduction of artificial intelligence methods into the practice of analyzing, processing and interpreting linguistic data. Modern philological research is increasingly based on the interdisciplinary integration of humanitarian and mathematical and technical approaches, which contributes to the formation of new methodological models of hybrid studying language, text and communication processes [1].

One of the most promising areas of such scientific synthesis is the use of hybrid artificial intelligence, which combines the methods of machine learning, neural networks, symbolic programming and formalized linguistic rules [2]. Hybrid intelligent systems allow to partially overcome the limitations of



traditional statistical or exclusively neural network models of natural language processing, providing a more comprehensive understanding of the semantic, pragmatic and cultural characteristics of the text. In modern linguistics, such systems are used to solve a wide range of tasks, including automated translation, semantic analysis, natural language processing, corpus research, discourse analysis, and modeling of intercultural communication processes [3], [4]. By integrating algorithmic methods with theoretical linguistic knowledge, hybrid artificial intelligence becomes an effective tool for studying complex language structures and communicative phenomena.

In the context of modern global philological trends, the development of digital humanities is of particular importance, within which artificial intelligence technologies are actively used to analyze large-scale arrays of text information, form electronic corpora, and develop intelligent systems to support scientific research.

As a result, philology is gradually transforming from a predominantly interpretive discipline into a scientific field that actively uses computational methods for analyzing language and text data.

Therefore, researching the potential of applying hybrid artificial intelligence in philology is a relevant scientific task, as it contributes to expanding the methodological tools of modern linguistics and increasing the efficiency of analyzing language and text structures in the context of the digitalization of the humanities.

FORMULATION OF THE PROBLEM

Despite the active spread of artificial intelligence technologies and their widespread use in various scientific fields, the issue of their comprehensive application in philological research remains insufficiently developed. In particular, in modern linguistics there is a certain gap between traditional theoretical approaches to language study and new computational methods for text data analysis. In addition, the possibilities of integrating hybrid intelligent systems into the processes of philological analysis, text interpretation, modeling of language processes and the study of intercultural communication have not been sufficiently explored.

In the context of modern global philological trends associated with the development of digital humanities, corpus linguistics and natural language processing technologies, there is a need for a deeper theoretical understanding of the role of hybrid artificial intelligence in philological research. This makes it urgent to study the potential of hybrid intelligent systems for the analysis of language structures, processing text corpora and studying communicative processes in the modern information space.



ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

The current state of development of machine linguistics is characterized by the transition from purely empirical statistical methods to the deep integration of linguistic theory into the architecture of artificial intelligence. Analyzing the foundation of modern discussions, one should pay attention to the work of K. Church and M. Liberman [5], who consider the future of computational linguistics through the prism of overcoming the “alchemical” approach - a situation when practical results outpace theoretical understanding of processes. The authors call for a return to fundamental linguistic principles, which correlates with the position of M. McShane and S. Nirenburg [7], who in their monograph substantiate the concept of linguistics for the “AI era”. They prove that a true understanding of natural language by a machine is impossible without taking into account the multi-level structure of knowledge that goes beyond simple processing of big data. In parallel, N. Tasheva [16] systematizes the evolution of key linguistic concepts, demonstrating how traditional categories are transformed in the digital paradigm.

The technological dimension of modern research focuses on improving the architectures of language models. D. Oralbekova et al. [11] describe in detail the evolution of approaches to building language models, emphasizing the transition to more complex context processing mechanisms. An important aspect in this context is the work of H. Kissane, A. Schilling and P. Krauss [13], who propose methods for visualizing and analyzing internal representations in large language models (using the example of BERT). Their study of neural representations of phrasal verbs allows us to better understand how deep networks structure linguistic information. At the same time, the problem of accuracy and verifiability of generated texts is considered by H. Li et al. [9], analyzing Retrieval-augmented generation (RAG) technologies, which allow integrating external knowledge into the generation process, minimizing the risks of factual errors.

A special place in the modern scientific discussion is occupied by the search for a compromise between neural network and symbolic methods.

R. Panchendrarajan and A. Zubiaga [14, 17] in their reviews substantiate the advantages of hybrid approaches that combine the flexibility of machine learning with the clear logic of symbolic knowledge. Such a synthesis allows solving complex NLP tasks with a higher level of interpretability of results. The issues of reliability and mathematical certainty of models in their predictions are expanded by M. Campos et al. [18], proposing the implementation of conformal prediction methods for natural language processing, which is critically important for systems where the cost of error is high.

Applied aspects of machine linguistics cover a wide range of problems: from multilingualism to specific professional domains. In particular, G. I. Winata et al. [8] conduct an in-depth analysis of trends in the study of code-switching, a



challenge for modern NLP systems in a globalized world. T. R. Gatla [12] and his colleagues emphasize the role of technology in overcoming language barriers, while P. Krasadakis, E. Sakkopoulos and V. S. Verykios [19] focus on the specifics of text processing in legal informatics and the problems of supporting low-resource languages. The deep connection between semantic categories and computational methods is analyzed in a recent work by A. Ahmad et al. [20], which emphasizes the complexity of formalizing semantic nuances.

The transformation of the linguistic field inevitably affects the educational and socio-cultural spheres. W. Li [6] and O. B. Jalilbayli [10] justify the need to reform linguistic education, proposing strategies for training specialists capable of operating with artificial intelligence tools. In addition, one cannot ignore the change in the axiological content of modern language, which is studied by I. S. Stepanova, S. S. Nykyporets and N. M. Gadaychuk [15], pointing to the dynamics of value concepts in the modern linguistic space. Thus, the analysis of recent publications indicates the formation of an interdisciplinary field, where the technical achievements of computational linguistics are closely intertwined with theoretical linguistics, education and ethics. Considering the above, despite the active development of intellectual technologies, the issue of their comprehensive use in philological research remains insufficiently studied. In particular, there remains a need for a deeper and more comprehensive study of the possibilities of integrating hybrid intelligent systems into the analysis of language processes and text data precisely in the context of all modern global philological trends.

PURPOSE OF THE ARTICLE

The purpose of this article is to analyze the features of the use of hybrid artificial intelligence in philology, primarily in linguistics, as well as to determine its role and functional capabilities in the context of modern world philological trends.

To achieve this goal, it is planned to solve a number of scientific tasks, including: research into the main areas of application of artificial intelligence technologies in philological research; determining the specifics of hybrid artificial intelligence models in the processes of processing and analyzing language data; considering the possibilities of integrating computational methods with traditional linguistic approaches; and identifying promising areas for the development of hybrid intelligent technologies in modern philological science.

RESULTS

The current stage of development of philology and linguistics is characterized by intensive digital transformation of scientific research, a significant increase in the volume of text information and the active implementation of



intelligent data analysis technologies. In such conditions, the use of hybrid artificial intelligence, which combines various machine learning methods , symbolic mechanisms for representing knowledge and statistical approaches to processing language data, becomes particularly relevant . Such an integrative model opens up new opportunities for philological research and contributes to increasing the accuracy of automated analysis and interpretation of language structures .

Hybrid Artificial Intelligence is a scientific and technological concept based on a combination of neural network architectures, statistical methods for processing natural language and formalized knowledge systems. Unlike classical machine learning algorithms, which are focused mainly on processing large data sets using probabilistic models, hybrid intelligent systems are able to combine quantitative methods of text analysis with logical-semantic mechanisms for modeling language structures. This creates a comprehensive language learning tool that allows you to take into account both the structural characteristics of language units and the cognitive features of their functioning. Table 1 systematizes how the integration of different methodologies overcomes the limitations of standalone models.

Table 1

Technological Structure and Advantages of Hybrid AI

Component of the Hybrid Model	Description and Functional Role	Resulting Effect (Advantage)
<i>Neural Network Architectures</i>	Utilization of deep learning to process large-scale datasets	High flexibility and the ability to learn complex linguistic patterns
<i>Statistical Methods</i>	Probabilistic modeling and frequency analysis of language units	Efficient processing of massive text arrays and identification of regularities
<i>Symbolic Mechanisms / Formalized Rules</i>	Application of strict grammatical rules and logical-semantic knowledge representation	Ensures high accuracy for languages with complex morphology and provides interpretable results

Source: authors' research results

In modern philology, hybrid artificial intelligence systems are actively used in computational linguistics, corpus analysis, automated translation, discourse research, and semantic modeling of texts. One of the most significant areas is



Natural Language Processing (NLP), where hybrid architectures make it possible to combine the potential of deep neural networks with formalized rules of grammatical analysis. Such a combination is especially important for languages with a complex morphological system, since exclusively statistical models are not always able to provide sufficient accuracy in processing language data.

One of the key global directions in the development of modern philology is the transition from traditional descriptive methods of language study to large-scale analysis of ext corpora. The expansion of digital libraries, electronic archives, and multilingual text databases has contributed to the formation of a new scientific direction - Digital Philology. Within this research field, hybrid artificial intelligence systems are used for automated classification of texts, identification of semantic relationships between lexical units, analysis of stylistic features of authorial texts, and study of the historical dynamics of language changes.

Hybrid artificial intelligence plays a special role in the study of intercultural and interlingual communication. Modern machine translation technologies demonstrate a significant level of efficiency due to the use of hybrid models that combine neural algorithms and linguistic rules. Such integration allows us to take into account not only statistical regularities of language functioning, but also semantic, pragmatic and cultural features of different language systems. As a result, the quality of automated translation is significantly improved, especially when working with specialized texts of scientific, legal or technical content.

An additional area of application of hybrid intelligent technologies in philological research is automated discourse analysis. The use of modern artificial intelligence algorithms allows us to detect hidden semantic structures of the text, identify thematic clusters, and even explore pragmatic aspects of linguistic communication. Similar methods are widely used in media linguistics, political discourse analysis and sociolinguistic studies, where there is a need to process large amounts of text data.

The following areas represent where the integration of intelligent systems yields the most significant practical results – see Table 2.

Table 2

Application Areas of Hybrid AI in Contemporary Philology

Application Area	Key Tasks and Functions	Impact on the Field
<i>Natural Language Processing (NLP)</i>	Combining deep neural networks with formalized rules of grammatical analysis	Provides superior accuracy in processing languages with complex morphological systems



Application Area	Key Tasks and Functions	Impact on the Field
<i>Digital Philology</i>	Automated text classification, identification of semantic relationships, and stylistic analysis	Shifts the focus from descriptive methods to large-scale corpus-based analysis
<i>Machine Translation & Communication</i>	Integrating neural algorithms with specific linguistic and cultural rules	Significantly improves translation quality for specialized scientific, legal, or technical content
<i>Discourse Analysis</i>	Detecting hidden semantic structures, thematic clusters, and pragmatic aspects of communication	Enables efficient processing of vast amounts of data in media and political linguistics

Source: authors' research results

Modern global trends in the development of philological sciences also demonstrate the strengthening of interdisciplinary approaches that combine linguistics, information technologies, cognitive sciences and mathematical modeling.

Within the framework of such a scientific paradigm, hybrid artificial intelligence acts as a tool for integrating various research methodologies. It provides an opportunity to model complex language processes, including the formation of meanings, cognitive interpretation of texts and the dynamics of the transformation of language systems in the conditions of a digital communication environment.

The application of hybrid intelligent systems in scientific and educational philology deserves special attention. Intelligent platforms for text data analysis allow to automate the processes of annotation, indexing and thematic systematization of scientific publications.

In addition, hybrid algorithms are actively used to develop intelligent systems for supporting translation, automated text editing and analysis of academic discourse. This contributes to increasing the efficiency of scientific communication and expands the possibilities for the development of digital humanities research.

The table 3 - outlines the shift in methodology and research approaches within the discipline.



Table 3.

Transformation of the Philological Paradigm under the Influence of AI

Parameter of Comparison	Traditional Philology	Contemporary Philology (Hybrid AI Era)
<i>Primary Methodology</i>	Predominantly interpretive and descriptive methods	Active utilization of computational data analysis and modeling
<i>Object of Study</i>	Individual texts or small samples of language units	Large-scale text arrays, electronic corpora, and global databases
<i>Nature of the Discipline</i>	A humanities-focused interpretive field	An interdisciplinary field merging linguistics, IT, and cognitive sciences
<i>Scope of Results</i>	Qualitative analysis often limited by subjective interpretation	High-accuracy modeling of meaning formation and cognitive text interpretation

Source: authors' research results

Thus, the introduction of hybrid artificial intelligence forms a qualitatively new paradigm for the development of modern philology. The integration of neural network technologies, statistical methods and symbolic models of knowledge processing allows us to significantly expand the analytical capabilities of linguistic research. In the case of global digitalization of the scientific space, hybrid intelligent systems become an important tool for studying language processes, intercultural communication and the evolution of text practices in the modern information society.

CONCLUSIONS

The research carried out allows us to develop a conclusion that the use of new technologies of hybrid artificial intelligence significantly expands the methodological capabilities of modern philology and linguistics. Integration of neural boundary models of machine learning with symbolic linguistic rules will ensure greater accuracy of processing of physical information and facilitate a more in-depth understanding of structural, semantic and pragmatic characteristics of the text.

The development of hybrid intelligent systems opens up new possibilities for developing a wide range of tasks for philological analysis, including automatic recognition and interpretation of linguistic constructions, semantic modeling texts, analysis of discursive practices, processing of great text corpora and in-



depth knowledge of machine translation technologies. The main advantage of hybrid approaches is the combination of statistical algorithms with formalized linguistic knowledge, which facilitates increased understanding and interpretation of the results of automated analysis.

Within the framework of global trends in the development of philological research, the integration of artificial intelligence into digital humanities plays a special role.

The development of hybrid intelligent technologies combines the development of new, state-of-the-art tools that make it possible to analyze natural phenomena on a completely different level and identify patterns. the functioning of language in various communicative and sociocultural contexts.

Thus, the introduction of hybrid piece intelligence in philological research can be seen as an important stage in the modernization of humanities knowledge, which opens up new possibilities for the complex learning of language, text and intercultural interaction.

PROSPECTS FOR FUTURE RESEARCH

The prospects for further research in the field of stagnation of hybrid artificial intelligence in philology are connected with the deepening of interdisciplinary interaction between linguistics, computer science, mathematical modeling and cognitive sciences. This allows us to develop detailed intelligent systems that will capture complex semantic, pragmatic and cultural aspects of social communication.

One of the promising scientific directions is the thorough development of hybrid models of processing natural language, which combines deep neural measures with formalized linguistic knowledge, ontological structures and semantic databases. This creates a change in the accuracy of automatic translation, discourse analysis, recognition of contextual meaning and interpretation of richly meaningful constructions.

Further research and development of methods for analyzing large text arrays and the creation of intelligent systems for processing digital archives will allow us to identify new patterns of the evolution of languages, literary traditions and cultural discourses.

In addition, it is promising to use hybrid intelligence for modeling processes of intercultural communication and tracking sociolinguistic phenomena in the global information space.

Therefore, the further development of hybrid intellectual technologies in the field of philology will lead to the formation of new scientific paradigms, the expansion of the pre-research capabilities of humanities disciplines and the deeper understanding of language as a foldable dynamic system human gathering.



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Дата першого надходження статті до видання: 15.03.2026

Дата прийняття статті до друку після рецензування: 29.03.2026