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THE EVOLUTION OF COMPUTATIONAL LINGUISTICS AND ARTIFICIAL INTELLIGENCE PARADIGMS IN TRANSLATION STUDIES AND THEIR LINGUISTIC FOUNDATIONS

Sevara Bakhtiyorovna Khamidova
Head of the English Language Department
Jizzakh State Pedagogical University
Jizzakh, Uzbekistan

ABOUT ARTICLE

Key words: computer linguistics, artificial intelligence (AI) paradigms, rule-based, statistical machine translation, neural machine translation (NMT).

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Abstract: This article explores the development of computer linguistics and artificial intelligence (AI) paradigms in translation studies, comparing traditional human-centered approaches with modern technological methods. It traces the evolution of machine translation from rule-based and statistical systems to neural machine translation (NMT), emphasizing how these advances have transformed the translation process. Particular attention is given to the difficulties of applying AI-based translation to typologically different languages such as English and Uzbek, including challenges related to morphology, syntax, and semantic ambiguity. The study concludes that although AI significantly broadens the scope of translation studies, it functions mainly as an assistive tool, while human translators remain essential for cultural and contextual accuracy.

TARJIMA TADQIQOTLARIDA HISOBLASH LINGVISTIKASINING VA SUN'IY INTELLEKT PARADIGMALARINING EVOLYUTSIYASI HAMDA ULARNING LINGVISTIK ASOSLARI

Sevara Baxtiyorovna Xamidova
Ingliz tili kafedra mudiri
Jizzax davlat pedagogika universiteti
Jizzax, O'zbekiston

MAQOLA HAQIDA

Kalit so'zlar: kompyuter lingvistikasi, sun'iy intellekt (AI) paradigmalari, qoidaga

Annotatsiya: Ushbu maqola tarjima tadqiqotlari doirasida kompyuter lingvistikasi

asoslangan mashina tarjimasi, statistik mashina tarjimasi, neyron mashina tarjimasi (NMT).

va sun’iy intellekt (SI) paradigmalari rivojlanishini o‘rganib, an’anaviy inson markazli yondashuvlarni zamonaviy texnologik usullar bilan taqqoslaydi. Unda mashina tarjimasining qoidaga asoslangan va statistik tizimlardan neyron mashina tarjimasi (NMT) ga qadar bo‘lgan evolyutsiyasi yoritilib, bu yutuqlarning tarjima jarayonini qanday o‘zgartirgani ta’kidlanadi. Tadqiqotda, ayniqsa, ingliz va o‘zbek kabi tipologik jihatdan farqli tillarga SI asosidagi tarjimani qo‘llashdagi qiyinchiliklarga, jumladan morfologiya, sintaksis va semantik noaniqlik muammolariga alohida e’tibor qaratiladi. Xulosa qilib aytganda, SI tarjima tadqiqotlarining doirasini sezilarli darajada kengaytirsa-da, u asosan yordamchi vosita sifatida xizmat qiladi, chunki madaniy va kontekstual aniqlikda inson tarjimonlarining roli hanuz muhimligicha qolmoqda.

ЭВОЛЮЦИЯ ВЫЧИСЛИТЕЛЬНОЙ ЛИНГВИСТИКИ И ПАРАДИГМ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ПЕРЕВОДОВЕДЕНИИ И ИХ ЛИНГВИСТИЧЕСКИЕ ОСНОВЫ

Севара Бахтияровна Хамидова
Заведующая кафедрой английского языка
Джизакский государственный педагогический университет
Джизак, Узбекистан

О СТАТЬЕ

Ключевые слова: компьютерная лингвистика, парадигмы искусственного интеллекта (ИИ), машинный перевод на основе правил, статистический машинный перевод, нейронный машинный перевод.

Аннотация: В статье рассматривается развитие компьютерной лингвистики и парадигм искусственного интеллекта (ИИ) в области переводоведения, сопоставляя традиционные человекоцентричные подходы с современными технологическими методами. В ней прослеживается эволюция машинного перевода от правил-ориентированных и статистических систем к нейронному машинному переводу, подчеркивая, как эти достижения изменили процесс перевода. Особое внимание уделяется трудностям применения ИИ-перевода к типологически различным языкам, таким как английский и узбекский, включая проблемы морфологии, синтаксиса и семантической неоднозначности. В заключение делается вывод, что хотя ИИ значительно расширяет рамки переводоведения, он в основном выполняет вспомогательную функцию,

тогда как человеческие переводчики остаются незаменимыми благодаря их культурным и контекстуальным знаниям.

In recent decades, translation studies have entered a fundamentally new stage of development. In particular, the evolution of computer linguistics and artificial intelligence paradigms in translation studies has become one of the most pressing and promising areas of scholarly research. Under conditions of globalization, digital communication, and the rapid expansion of multilingual information spaces, translation is no longer perceived solely as a linguistic activity but increasingly as a complex technological and cognitive process.

Traditional translation theories were primarily centered on human cognitive abilities and linguistic competence. However, the emergence of computer linguistics and artificial intelligence has radically transformed the conceptualization of translation, introducing algorithmic, statistical, and neural models into the translation process. As a result, translation has evolved into a hybrid domain in which human expertise and machine intelligence interact dynamically.

This article aims to provide a comprehensive analysis of the evolution of computer linguistics and artificial intelligence paradigms in translation studies, examining their linguistic foundations through a comparative study of English and Uzbek.

The Development of Translation Studies and Digital Paradigms. Translation studies initially emerged within the framework of philology and general linguistics. During the mid-twentieth century, scholars such as Eugene Nida, J. C. Catford, and Hans Vermeer laid the theoretical foundations of the discipline by introducing concepts of equivalence, functional adequacy, and skopos theory.

With the advancement of digital technologies in the twenty-first century, translation studies have undergone a paradigmatic shift. The integration of computer linguistics and artificial intelligence has enabled the automation and modeling of translation processes, fundamentally altering both the theory and practice of translation. Consequently, translation is now understood as a computational process involving data processing, pattern recognition, and probabilistic modeling.

From Traditional Translation Theories to Automated Translation Systems.Traditional translation theories emphasized semantic equivalence, communicative intent, and cultural transfer. In contrast, automated translation systems conceptualize translation as a sequence of computational operations.

This transition has led to several paradigm shifts:

• the translator → the human–machine interaction model

• the text → a structured dataset

• meaning → a computational semantic representation

• translation process → an algorithmic procedure

These transformations necessitate a re-evaluation of the epistemological foundations of translation studies.

Computer Linguistics: Theoretical Foundations and Methodology. Computer linguistics is an interdisciplinary field that models language using formal, mathematical, and computational methods. It integrates linguistics with computer science, artificial intelligence, and cognitive science.

In translation studies, computer linguistics enables:

• morphological analysis and lemmatization,

• syntactic parsing,

• semantic annotation,

• automatic text alignment and corpus processing.

From a comparative perspective, English and Uzbek present distinct challenges for computational modeling. English is characterized by relatively fixed word order and limited inflection, whereas Uzbek is an agglutinative language with extensive morphological variation and relatively free word order. These typological differences significantly affect the performance of machine translation systems.

The Evolution of Artificial Intelligence Paradigms in Translation Technologies

Rule-Based Machine Translation: Early machine translation systems relied on rule-based approaches, employing explicit grammatical rules and bilingual dictionaries. Although linguistically motivated, these systems struggled to account for contextual meaning, idiomatic expressions, and morphological complexity—particularly in agglutinative languages such as Uzbek.

Statistical Machine Translation: Statistical machine translation (SMT) marked a major shift toward data-driven approaches. SMT systems rely on probabilistic models derived from large parallel corpora. While effective for high-resource languages such as English, SMT systems showed limited success for Uzbek due to insufficient corpora and morphological richness.

Neural Machine Translation: Neural machine translation (NMT) represents the most advanced stage of machine translation development. Based on deep learning and neural networks, NMT systems model translation at the sentence and discourse levels, capturing contextual and semantic relationships more effectively.

Despite these advances, NMT systems still face challenges in translating complex grammatical structures, pragmatic meanings, and culturally bound expressions—particularly in English–Uzbek translation.

Linguistic Foundations: Semantics, Syntax, and Pragmatics

Semantic Challenges:Semantic ambiguity, polysemy, and figurative language pose significant challenges for machine translation. Although neural models use semantic embeddings to approximate meaning, they often fail to capture deeper conceptual and cultural nuances.

Syntactic Differences: English relies heavily on word order to convey grammatical relations, whereas Uzbek uses morphological markers. As a result, syntactic restructuring is often required during translation, which machine systems do not always perform adequately.

Pragmatic and Cultural Factors: Pragmatics plays a crucial role in translation quality. Speech acts, politeness strategies, and indirect expressions differ significantly between English and Uzbek. Artificial intelligence systems remain limited in their ability to model situational and cultural context.

Comparative Problems in English–Uzbek Machine Translation.The comparative analysis reveals several persistent challenges:

• morphological misalignment,

• lexical ambiguity,

• syntactic restructuring,

• pragmatic and cultural inadequacy.

These issues demonstrate that machine translation systems, despite their sophistication, cannot fully replace human translators.

The Epistemological Significance of Artificial Intelligence in Translation Studies. Artificial intelligence has expanded the epistemological boundaries of translation studies by introducing computational and cognitive perspectives. Translation is now viewed not only as linguistic transfer but also as a form of knowledge representation and processing.

Nevertheless, artificial intelligence primarily serves as a support tool rather than an autonomous translator. Optimal translation quality is achieved through human–machine collaboration.

Prospects for Integrating Translation Studies and Artificial Intelligence. Future research directions include:

• developing neural models for low-resource languages,

• expanding English–Uzbek parallel corpora,

• integrating pragmatic and cultural knowledge into translation systems,

• enhancing human–machine interaction in translation workflows.

These developments will further strengthen the theoretical and practical foundations of translation studies.

Conclusion. This study has examined the evolution of computer linguistics and artificial intelligence paradigms in translation studies, focusing on their linguistic foundations through a comparative analysis of the English and Uzbek languages. The findings indicate that while machine translation technologies have advanced significantly, typological, semantic, and pragmatic differences continue to limit their effectiveness.

Artificial intelligence has introduced a new scientific paradigm in translation studies, enriching its methodological and epistemological framework. However, the role of the human translator remains indispensable, particularly in ensuring cultural and pragmatic adequacy.

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