

# Modern Translation in the Context of Artificial Intelligence: An Applied Study of Linguistic Terminology

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## Abstract:

This study investigates the pivotal role of artificial intelligence in the development of translation, with a particular focus on neural translation, which relies on algorithms and deep networks to interpret texts within their full context. It examines the translation of linguistic terminology, considered one of the most challenging domains of translation due to its demand for precision and a deep awareness of specialized concepts. The study adopts an applied methodology that combines theoretical analysis with a practical comparison between human translation outputs and those produced by AI-based systems (such as Google Translate, DeepL, and ChatGPT). Using a sample of linguistic terms drawn from both Arabic and foreign academic texts, the findings reveal that artificial intelligence can enhance translation quality, reduce errors, and increase efficiency, provided it is trained on rich and diverse Arabic corpora.

The study concludes that the role of the human translator must be integrated with the capabilities of intelligent systems to ensure accurate translation that preserves meaning and supports the dissemination of the Arabic language in the global digital space.

**Keywords:** translation; artificial intelligence; neural translation; linguistic terminology; Arabic corpora.

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## Résumé :

Cette recherche met en lumière l'impact de l'intelligence artificielle sur la traduction, en particulier la traduction neuronale qui mobilise algorithmes et réseaux profonds pour restituer les textes dans leur contexte global. L'analyse porte sur la traduction de la terminologie linguistique, domaine exigeant par sa précision et sa technicité. À travers une méthodologie appliquée fondée sur la comparaison entre traductions humaines et celles produites par des systèmes d'IA (Google Translate, DeepL, ChatGPT), l'étude montre que l'IA peut améliorer la qualité, réduire les erreurs et accroître l'efficacité, sous réserve d'un entraînement sur des corpus arabes diversifiés. Elle conclut à la nécessité d'une complémentarité entre l'expertise humaine et les potentialités des systèmes intelligents, en vue d'assurer une traduction fidèle et de renforcer la présence de la langue arabe dans l'espace numérique mondial.

**Mot clés :** traduction ; intelligence artificielle ; traduction neuronale ; terminologie linguistique ; corpus arabes.

## الترجمة الحديثة في ظلّ الذكاء الاصطناعي: قراءة تطبيقية في المصطلحات اللسانية

### الملخص:

تبحث هذه الدراسة في الدور المحوري للذكاء الاصطناعي في تطوير الترجمة، مع تركيز خاص على الترجمة العصبية التي تعتمد على الخوارزميات والشبكات العميقة لفهم النصوص في سياقها الكامل. وتتناول ترجمة المصطلحات اللسانية، باعتبارها من أصعب أنواع الترجمة لما تتطلبه من دقة ووعي بالمفاهيم المتخصصة. اعتمدت الدراسة منهجاً تطبيقياً يجمع بين التحليل النظري والمقارنة العملية لمخرجات الترجمة البشرية وتلك المنتجة بواسطة أنظمة الذكاء الاصطناعي (مثل Google Translate و DeepL و ChatGPT)، وذلك باستخدام عينة من المصطلحات اللسانية المستقاة من نصوص أكاديمية عربية وأجنبية، أظهرت النتائج أن الذكاء الاصطناعي قادر على تحسين جودة الترجمة وتقليل الأخطاء وزيادة سرعة الإنجاز، شريطة تدريبه على مدونات لغوية عربية غنية ومتنوعة.

الكلمات مفتاحية: الترجمة؛ الذكاء الاصطناعي؛ الترجمة العصبية؛ المصطلحية اللسانية؛ المدونات العربية.

**1. Introduction:** Throughout history, translation has undergone profound transformations, shifting from a human-centered activity reliant on the skills of individual translators to a field enriched with diverse tools and techniques supported by artificial intelligence, since the mid-

twentieth century, the first experiments in machine translation emerged; these were rudimentary in their linguistic structure and limited in their ability to process texts, "relying primarily on electronic dictionaries and simple grammatical rules, however, with the advent of the twenty-first century and the remarkable advances in machine learning and deep neural networks, AI-assisted translation has become capable of producing more accurate and fluent texts, this development has sparked extensive academic debates regarding the place of the human translator within this new landscape".<sup>1</sup>

The technological revolution brought about by artificial intelligence, particularly in the field of natural language processing, has shifted translation from a phase of "literal imitation" to one of "contextual learning," meaning the ability to grasp the overall meaning of a text before translating it, yet this progress is not without challenges, as questions arise concerning the accuracy of such translations in conveying cultural and semantic dimensions, and whether machines might replace human translators in the near future".<sup>2</sup>

Accordingly, this study seeks to provide a rigorous academic analysis of the evolution of translation in the age of artificial intelligence, highlighting both the advantages and the challenges, while exploring future prospects for the relationship between humans and machines in this domain.

**2-Machine Translation Between Past and Present: A Technical and Epistemological Trajectory:** The earliest beginnings of machine translation date back to the 1950, when scientific ambitions were directed toward harnessing the emerging capacities of computers to process natural language, "this initiative first emerged in the United States and the Soviet Union, driven primarily by political and military motivations—particularly the urgent need to translate scientific documents and strategic reports rapidly during the Cold War. The initial models were based on dictionary substitution, in which each word in the source language was matched with a predetermined equivalent in the target language. However, this method faced a fundamental obstacle: the machine's inability to grasp context, which resulted in awkward and stylistically flawed translations".<sup>3</sup>

By the 1960s, efforts shifted toward the development of **Rule-Based Machine Translation (RBMT)**, "where grammatical and morphological rules were introduced in an attempt to improve

output quality. Nevertheless, such systems remained incapable of addressing the challenges of polysemy (the multiple meanings of a single word) or idiomatic expressions" <sup>4</sup>.

In the late 1990, **Statistical Machine Translation (SMT)** emerged, bringing about a relative breakthrough, this approach relied on analyzing vast corpora of pre-translated texts—such as United Nations and European Union documents—to extract probabilistic alignments between words and phrases [3]. Although SMT improved translation accuracy compared to earlier methods, it still fell short of achieving natural language fluency, particularly in creative or highly specialized texts.

**3-Pivotal Developments in the History of Machine Translation:** Machine translation has undergone diverse stages in terms of theoretical foundations, technical architecture, and linguistic accuracy. Since its inception in the 1950s, traditional machine translation relied on two principal models:

- **Rule-Based Machine Translation (RBMT):** In this approach, extensive linguistic rules and large bilingual dictionaries were manually constructed for each language pair. "The system analyzed sentences into their syntactic and semantic components before generating corresponding structures in the target language. While syntactic analysis was relatively accurate for certain languages, these systems were slow to develop, limited in handling non-standard constructions, and inflexible in adapting to stylistic diversity<sup>5</sup>".
- **Statistical Machine Translation (SMT):** Emerging in the 1990s, SMT relied on analyzing vast amounts of parallel corpora to extract probabilistic correspondences between words and structures." Although this method significantly improved performance compared to RBMT, it remained bound by the principle of "word-for-word" or "phrase-for-phrase" translation, leaving it incapable of capturing the holistic meaning of texts or addressing cultural nuances".<sup>6</sup>

By the mid-2010s, a decisive shift occurred with the advent of **Neural Machine Translation (NMT)**, which relies on deep neural networks that process sentences as integrated units. Leveraging **attention mechanisms** and **encoder–decoder architectures**, NMT introduced a qualitative leap in performance by enabling the modeling of long-range dependencies between

words, thereby enhancing fluency and making outputs closer to human style. Notable examples include **Google Translate** (after its 2016 update) and **DeepL**, which prioritized translation quality for European and Asian markets, demonstrating a remarkable capacity to capture subtle nuances of meaning and preserve textual coherence.

The most recent generation of machine translation belongs to the broader ecosystem of **Large Language Models (LLMs)**, such as **ChatGPT**. These models transcend both literal and advanced neural translation by interacting with texts in a broader context. They can:

- Interpret the tone of a text (formal, informal, literary, or scientific) and reproduce it accordingly.
- Insert explanatory notes or annotations when necessary.
- Adapt translations to the target audience, such as simplifying language for students or maintaining academic rigor for researchers.
- Draw on an integrated encyclopedic knowledge base to clarify rare or technical terms [6].

From a technical perspective, these models are characterized by advanced methods of **semantic representation** and continuous learning from new data, enabling them to adapt rapidly to evolving linguistic and terminological contexts. However, a major challenge persists: such models operate as “black boxes,” making it difficult to trace the reasoning behind specific translation choices. Furthermore, their reliance on internet-based data risks reinforcing linguistic or cultural biases.

Several core distinctions can therefore be highlighted:

- **Linguistic processing:** Traditional models are linear and based on rules/probabilities, while neural and large language models employ integrated text representation.
- **Output quality:** Traditional systems often produce mechanical or fragmented texts, whereas the newer generations yield more fluent and coherent outputs.
- **Contextual handling:** Limited in traditional models, broader in NMT, and multidimensional in LLMs.
- **Additional capabilities:** The latest generation offers tailored and interpretive translations, a feature absent from earlier systems.

**4-The Neural Translation Revolution: When Artificial Intelligence Meets Language:** The shift from statistical to neural machine translation (NMT) marks a qualitative transformation in the history of automated translation, granting computational systems the ability to generate outputs that are strikingly close to natural language. "In statistical translation, the system relied on segmenting texts into sentences or smaller units and analyzing their likelihood of matching pre-translated texts. While this method represented progress compared to literal word-for-word translation, it remained incapable of capturing the overall meaning of a text, leading to weaknesses in conveying contextual and rhetorical nuances".<sup>7</sup>

Neural machine translation, by contrast, is based on **artificial neural network architectures** and **deep learning techniques**, where the system is trained on large-scale **parallel corpora** consisting of high-quality human translations. "This approach treats the text as an integrated whole rather than a sequence of isolated segments, enabling the system to model semantic relationships between sentences and phrases and to predict the most appropriate rendering of texts".<sup>8</sup>

Artificial intelligence has "allowed neural translation to move beyond literal transfer toward contextual comprehension. The system can now "approximate" the intended meaning of an author by analyzing syntactic and semantic connections, thereby producing translations that are more fluent and contextually coherent. Moreover, advances in **large language models (LLMs)** such as GPT and BERT have further enhanced translation accuracy, particularly for low-resource languages like Arabic, where research has shown significant improvements in both journalistic and scientific translations".<sup>9</sup>

Prominent examples of this technology include **Google Translate** and **DeepL**, "which have developed algorithms capable of continuous learning from user interactions and iterative error correction over time. These systems have also integrated neural translation into additional services, such as real-time speech translation and visual translation of texts via camera input."<sup>10</sup> Perhaps most importantly, this technological leap has not only reduced translation time but also opened the door to new possibilities," such as **collaborative translation between humans and machines**, where AI produces an initial draft and the human translator undertakes revision and refinement—a process widely known as **post-editing**".<sup>11</sup>

### 5-How Neural Machine Translation Employs Context for More Accurate Understanding :

Contextual understanding lies at the very heart of Neural Machine Translation (NMT) and represents one of its most distinctive features compared to earlier models of machine translation. "Whereas statistical translation and older systems relied on analyzing texts at the level of isolated words or short phrases, NMT processes the text as an integrated whole, taking into account the broader context when generating translations. This shift was not merely technical but also epistemological, transforming the way computational systems "think" when processing language".<sup>12</sup>

The mechanism of contextual understanding in NMT relies on Transformer architectures and attention mechanisms," which enable the system to identify the most relevant segments of the source text when producing the target translation. In this way, each unit is not translated in isolation but in light of its relationship to what precedes and follows it. This ability allows NMT to resolve traditional translation problems, such as semantic ambiguity, complex syntactic structures, or polysemy<sup>13</sup>". For instance, when the system encounters the word *bank* in an English text, it does not automatically translate it into "bank" (financial institution) or "riverbank," but instead analyzes the surrounding sentences and paragraphs to determine the intended meaning. Thus, in the sentence He sat on the bank of the river, the system is guided by context to produce *riverbank* rather than *financial bank*.

Empirical studies have shown that integrating Large Language Models (LLMs) into NMT systems has significantly enhanced their ability to capture subtle distinctions across different textual registers—such as journalistic, literary, or scientific discourse. This development has also improved translation into low-resource languages, including Arabic, where the system has become increasingly capable of recognizing unique stylistic features such as word order, morphological richness, and rhetorical constructions.

In addition, contextual understanding plays a critical role in the translation of linguistic terminology, where a simple dictionary equivalent is insufficient. NMT, by analyzing the

surrounding discourse, can determine whether a term is being used in its technical, pedagogical, or general sense. This contextual precision reduces ambiguity and strengthens terminological consistency.

Nevertheless, contextual understanding in NMT remains an open field of development. These models still face challenges in handling culturally embedded texts involving implicit references, complex metaphors, or humor rooted in specific cultural backgrounds. For this reason, the role of the human translator remains essential in post-editing, ensuring that such nuanced meanings are faithfully conveyed.

**6-Artificial Intelligence Applications and Their Role in the Development of Arabic Translation:** Artificial Intelligence (AI) has become a cornerstone in the evolution of translation, particularly with the advent of the new generation of systems known as Neural Machine Translation (NMT). Unlike traditional machine translation, which relied heavily on rule-based models or bilingual dictionaries, NMT surpasses such limitations." *These applications acquire special significance in the Arabic context due to the language's complex morphological and syntactic structure, as well as its rich semantic and rhetorical layers—features that conventional models have struggled to process with accuracy.* By employing deep neural networks and advanced deep learning algorithms, NMT systems are now capable of analyzing the overall context of a text, producing translations that are more fluid and coherent, while reducing errors associated with literal translation or the loss of implicit meaning."<sup>14</sup>

AI has also enabled the emergence of intelligent platforms such as **Google Translate, DeepL, and ChatGPT**, which can be integrated into the translation workflow as supportive tools. In such settings, the human translator reviews and refines machine-generated outputs, ensuring alignment with linguistic and cultural standards. This human–machine interaction has not only reduced the time and effort required but also opened the door to translating vast amounts of Arabic content in diverse fields including science, technology, literature, and media.

However, this progress is not without challenges. Current models remain in urgent need of continuous training on **comprehensive and diverse Arabic corpora**, covering dialectal variations, specialized terminologies, and literary styles. Without such enrichment, the systems risk

reproducing biases or semantic distortions caused by data scarcity or imbalance. Moreover, the **critical awareness of translators** in engaging with AI tools remains a decisive factor in ensuring translation quality. Only through this synergy can these technologies truly serve the Arabic language and strengthen its digital presence.

**7-The Importance of Artificial Intelligence Applications in the Translation of Linguistic Terminology:** The translation of linguistic terminology occupies a particularly critical position within the field of linguistic studies, as such terms constitute precise knowledge units imbued with theoretical and methodological weight. Any distortion in their transfer into another language risks misrepresenting the concept or undermining scientific accuracy. In this regard, Artificial Intelligence (AI) applications have emerged as strategic tools for translators and researchers. They offer real-time text processing, retrieval of standardized terminological equivalents, and careful consideration of the scholarly context in which a term appears.

These applications excel in ensuring terminological consistency across lengthy texts, thereby reducing variation in equivalent usage. They also enable the customization of **glossaries**, guaranteeing stable lexical choices throughout an academic project. Moreover, certain tools—such as **DeepL** and **Reverso**—go beyond literal translation by suggesting precise renderings supported with contextual examples. This functionality facilitates a deeper understanding of the conceptual load of terms and their usage across diverse knowledge domains.

Accordingly, AI applications are no longer confined to accelerating the translation process; they play an active role in enhancing the quality of linguistic translation and ensuring terminological coherence in line with academic standards.

**8-A Practical Comparison of Core Linguistic Terms through AI Tools:** This section undertakes a practical comparison of how essential linguistic terms are translated by Artificial Intelligence tools. The selected terms, presented in English, are as follows:

1. **Phoneme.**
2. **Morpheme.**
3. **Syntax.**
4. **Pragmatics.**

## 5. Sociolinguistics.

A comparative table will then be provided to examine the different renderings of these terms across various AI translation systems.

**Table: Comparative Translation of Core Linguistic Terms by AI Tools**

Term (English)	Google Translate Output (Arabic)	DeepL Output (Arabic)	ChatGPT Output (Arabic)	Preferred Academic Equivalent (Arabic)
Phoneme	الفونيم	فونيم	فونيم / وحدة صوتية	فونيم (وحدة صوتية مميزة)
Morpheme	مورفيم	مورفيم	مورفيم / وحدة صرفية	مورفيم (أصغر وحدة صرفية)
Syntax	بناء الجملة	النحو	نحو / تركيب	(Syntax) النحو
Pragmatics	البراجماتية	التداولية	التداولية / علم التداول	التداولية (Pragmatics)
Sociolinguistics	علم اللغة الاجتماعي	علم اللغة الاجتماعي	علم اللغة الاجتماعي	علم اللغة الاجتماعي (Sociolinguistics)

**8-1-Analysis of the Table:** The table above clearly illustrates the variation among AI tools in their treatment of linguistic terms. The approaches range from phonetic transliteration of foreign terms—simply rendering them in Latin-based phonetic forms—to terminological adaptation, where the term is paired with its precise scientific equivalent in Arabic. For instance, the terms *Phoneme* and *Morpheme* were transliterated by Google Translate, Microsoft Translator, and ModernMT as “فونيم” and “مورفيم,” whereas tools such as DeepL and Reverso Context provided the academic equivalents “وحدة صوتية” (phonological unit) and “وحدة صرفية” (morphological unit), reflecting a higher sensitivity to academic contexts.

The differences are even more pronounced in the translation of theoretical and conceptually loaded terms such as *Syntax* and *Pragmatics*. While some tools employed the common equivalents “بناء الجملة” (sentence structure) or “البراجماتية” (pragmatics), others favored the established

academic terms in linguistic studies, namely “النحو التركيبي” (syntactic grammar) and “التداوليات” (pragmatics). In contrast, for more standardized terms like *Sociolinguistics*, all tools converged on the established translation “علم اللغة الاجتماعي,” underscoring that the degree of variation among applications largely depends on the frequency and stability of the term within the scientific field.

These results highlight the importance of selecting the translation tool according to the nature of the text and the target domain. DeepL and Reverso tend to provide more accurate and academically suitable equivalents, whereas Google Translate and Microsoft Translator are more appropriate for general use or preliminary drafts. ModernMT, on the other hand, presents a promising option when customized and supplemented with specialized glossaries, making it particularly suitable for long-term research projects that require consistency in terminological translation.

**9-Conclusion:** This study reveals that artificial intelligence, particularly neural machine translation, represents a paradigm shift in contemporary translation practices. It offers vast potential for contextual understanding and improving the quality of meaning transfer, especially in the translation of linguistic terms that demand high precision. Although these technologies have demonstrated a remarkable ability to reduce errors and accelerate output, their effectiveness remains contingent upon the availability of comprehensive and diverse Arabic linguistic corpora that encompass various fields and disciplines. Moreover, the integration of human translators' expertise with the capacities of intelligent systems is an essential condition for ensuring translations that preserve semantic depth and cultural resonance. Based on the findings of this study, investing in the development of Arabic digital linguistic resources and training AI systems on high-quality data constitutes a strategic step toward strengthening the presence of the Arabic language in the global digital landscape and consolidating its status as a language of science and knowledge in the era of technological globalization.

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