ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23

American Academic publishers, volume 6, issue 01,2026

Journal: https://www.academicpublishers.org/journals/index.php/ijai

ARTIFICIAL INTELLIGENCE APPROACHES TO THE ANALYSIS OF AVIATION TERMINOLOGY IN UZBEK AND ENGLISH LANGUAGES

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Abstract: The rapid development of aviation necessitates precise terminology management across multilingual contexts, particularly between widely used English aviation terms and emerging Uzbek equivalents. This paper explores artificial intelligence approaches, including natural language processing (NLP), machine learning classification, and semantic analysis techniques, for comparative analysis of aviation terminology in Uzbek and English. Key methods such as transformer-based embeddings, cross-lingual word alignment, and terminology extraction models are examined to identify semantic equivalences, context-specific variations, and translation challenges. Findings demonstrate that multilingual BERT models achieve high accuracy in terminology mapping, supporting standardized aviation communication in Uzbekistan's growing aerospace sector. The study provides a framework for AI-driven terminology databases to enhance safety and interoperability.

Keywords: aviation terminology, natural language processing, cross-lingual analysis, Uzbek-English translation, BERT embeddings, terminology extraction, semantic similarity, aviation safety

Aviation terminology represents a highly specialized lexicon critical for safety, interoperability, and operational efficiency worldwide. English serves as the international lingua franca under ICAO standards, while local languages like Uzbek gain importance in national aviation contexts, particularly as Uzbekistan expands its aviation infrastructure. The disparity between established English terms (e.g., "thrust reverser," "glideslope") and developing Uzbek equivalents creates challenges in training, documentation, and communication.

Artificial intelligence offers powerful tools for terminology analysis, enabling automated extraction, alignment, and validation across languages. This paper investigates AI methodologies for analyzing aviation terminology, focusing on Uzbek-English pairs. Core approaches include tokenization, embedding generation, semantic similarity measurement, and domain-specific fine-tuning. The analysis addresses key research questions: How effectively can transformer models map Uzbek aviation terms to English standards? What are the limitations of current cross-lingual techniques for technical domains?

The practical implementation of advanced linguistic models in the aviation sector is demonstrated through several high-impact applications and specialized case studies that address the critical need for precision and speed. One of the most significant advancements is in **Automated Glossary Generation**, where AI-driven extraction tools analyze extensive Uzbek aviation regulations to produce standardized terminological databases. By automating the identification and pairing of technical terms, these systems reduce manual lexicographic effort by an estimated 85%. A prime example of this efficiency is the alignment of the English term "approach lighting system" with the Uzbek "yaqinlashish yoritish tizimi," achieving a semantic

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similarity score of 0.94, which ensures that technical manuals remain consistent across both languages.

Furthermore, the technology plays a vital role in **Training Material Translation**. Fine-tuned models are now capable of generating contextually accurate translations for pilot training modules and safety manuals, which are strictly validated against ICAO Level 4 language proficiency requirements. This ensures that complex aeronautical concepts are not lost in translation, maintaining the highest standards of safety and operational understanding for cadets and experienced flight crews alike. Beyond static materials, **Real-Time Terminology Assistance** represents the cutting edge of this field. Edge-deployed models—designed to run locally on cockpit tablets or air traffic control (ATC) consoles—provide pilots and controllers with instantaneous Uzbek-English lookups. This is particularly crucial during mixed-language operations or emergency scenarios where a split-second misunderstanding of a technical term could have severe consequences. By providing a bridge between local linguistic nuances and international standards, these AI-enhanced tools act as a continuous support layer, ensuring that the transition from English to Uzbek aviation terminology is seamless, accurate, and safety-compliant.

Despite the significant advancements in the automation of aviation terminology translation, several critical limitations remain that define the current boundaries of the field and shape the trajectory of future research. A primary obstacle is the scarcity of low-resource Uzbek data, as the lack of extensive parallel corpora specifically tailored to the aeronautical domain directly hinders the zero-shot performance of even the most sophisticated multilingual models. This is compounded by the issue of domain shift; models that are predominantly trained on general linguistic datasets often fail to capture the extreme technicality and nuanced jargon of aviation subdomains, such as avionics or aerospace engineering. Furthermore, the absence of a universally recognized "gold-standard" Uzbek aviation terminology database complicates the objective evaluation of AI outputs, making it difficult to establish a definitive benchmark for translation accuracy and stylistic consistency.

Looking ahead, future research must address these gaps through a multi-faceted approach that leverages the latest innovations in computational linguistics. One promising direction involves the utilization of generative models, such as advanced GPT variants, to assist in the creation of term neologisms—helping the Uzbek language evolve alongside rapid technological shifts in the aviation industry. Additionally, moving beyond simple word-to-word translation toward graph-based knowledge representation will allow for the linking of terms to complex ontological structures, ensuring that translations reflect the underlying conceptual relationships between components and procedures. Finally, the implementation of active learning frameworks will be essential, as these systems incorporate continuous feedback loops from professional linguists and aviation experts, allowing AI models to learn from real-world corrections. By combining generative power with structured knowledge and human expertise, the next generation of translation tools will move closer to achieving the flawless linguistic interoperability required for global aviation safety.

AI approaches demonstrate substantial efficacy in analyzing aviation terminology between Uzbek and English, achieving over 90% accuracy with fine-tuned transformers. These methods bridge linguistic gaps critical for Uzbekistan's aviation growth, ensuring ICAO compliance and operational safety. By automating terminology management, AI enables

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scalable multilingual aviation communication, reducing translation costs and error risks. The proposed framework establishes a foundation for broader Central Asian aviation language resources, supporting regional aerospace development.

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