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International Communication of Hainan Folk-Culture Terminology within a Cross-Modal AI Translation Framework

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Abstract: This study examines the dual challenges facing the international communication of Hainan's folk culture in the context of globalization-namely, cultural discount and terminology distortion-as well as the inherent limitations of traditional translation paradigms. At the theoretical level, it reconstructs the methodological foundation by integrating terminology studies with intercultural communication theory. At the technical level, it proposes an innovative cross-modal AI translation framework that incorporates neural machine translation optimization, multilingual semantic alignment model fusion, and a dynamic annotation-incremental learning mechanism. Empirical validation focuses on the cultural events "Sanyuesan" and the "Junpo Festival." A multimodal corpus was constructed, and models were trained and evaluated, ultimately supporting the formulation of three international standards. The research outcomes have already been applied in real-world settings and have demonstrated significant effectiveness. Future research will focus on federated learning, blockchain, and metaverse applications to further deepen the technological framework, expand the application ecosystem, and enhance the international dissemination of Hainan's folk culture.

Keywords: cross-modal AI translation; Hainan folk culture; international dissemination of terminology; international standards; technological innovation

1. Introduction

In the current surging tide of globalization, cultural exchange and communication have become increasingly frequent and profound, accompanied by a growing international demand for understanding diverse cultures. Hainan's folk culture, as a shining jewel within the treasury of Chinese civilization, embodies the unique charm and rich heritage resulting from multiethnic integration and should occupy a prominent position in global cultural exchange. However, the international dissemination of Hainan folk culture faces dual challenges: cultural discount, which diminishes the perceived value of local customs in foreign contexts, and terminology distortion, where culturally specific terms lose their meaning when translated across languages. Traditional translation paradigms, whether human or machine-based, have proven insufficient to effectively address these issues, limiting both the global reach of Hainan folk culture and the enhancement of China's cultural influence worldwide.

To tackle these challenges, this study proposes an innovative cross-modal AI translation framework aimed at overcoming existing limitations and providing a viable pathway for advancing the international transmission of Hainan folk-culture terminology. The framework integrates theoretical and technological innovations. On the theoretical side, it synergizes terminology studies with cross-cultural communication theory to construct a methodological foundation for accurate concept mapping and cultural adaptation. On the technological side, it incorporates neural machine translation

Published:19 December 2025



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optimization, multilingual semantic alignment, and dynamic annotation with incremental learning mechanisms. Empirical validation is conducted through case studies on the "Sanyuesan" and "Junpo Festival", supported by a multimodal corpus of textual, audio, and video data, and reinforced by international standardization efforts. The results demonstrate significant improvements in translation accuracy, cultural equivalence, and practical applicability, establishing a replicable model for global dissemination of Hainan folk culture, and offering valuable insights for the translation and promotion of other intangible cultural heritage worldwide [1].

2. Dual Challenges and Potential Solutions in the International Dissemination of Hainan Folk Culture under Globalization

2.1. Cultural Discount and Terminology Distortion: Core Challenges in the International Communication of Hainan Folk Culture

Hainan, as a key node of the "21st-Century Maritime Silk Road," possesses folk culture that embodies the unique integration of multiple ethnic groups, including the Li, Miao, and Han. Taking the "Sanyuesan" Festival (literally "Third of March Festival," a traditional Li ethnic celebration) and the "Junpo Festival" (a traditional folk festival featuring ancestral worship and community performances) as examples, related folk activities in 2024 attracted over 1.2 million overseas visitors. However, the cross-linguistic transmission of core terminology faces several structural contradictions.

First, culturally specific terms often lack equivalent translations. For example, the "Gongzu Xunyou" (literally "Ancestor Parade") in the Junpo Festival has been literally translated as "military parade," which entirely strips away the ritual core of ancestral worship and fails to convey the profound cultural significance behind it.

Second, Southeast Asian language resources are severely insufficient. In existing corpora, the coverage of Vietnamese and Indonesian is below 15%, which greatly limits the dissemination of Hainan folk culture in the ASEAN market.

Third, terminology standards are fragmented. The same concept is translated differently across platforms. For instance, the "Dachai Wu" (literally "Firewood Dance") appears as "Firewood Dance," "Xe Dang Dance," and "Stick Dance" in social media, academic literature, and tourist guides, respectively, causing confusion in international perception and hindering the accurate dissemination of Hainan folk culture [2].

2.2. Limitations of Traditional Translation Paradigms: The Dual Imbalance of Efficiency and Quality

Although human translation can ensure cultural accuracy to a certain extent, it suffers from high costs and lengthy turnaround times. For example, in the 2024 exhibition text translation at the Hainan Provincial Museum, the human translation team spent six months completing 200,000 words, with a cost exceeding 2,000 yuan per page. Moreover, 60% of the translations exhibited a loss of cultural imagery. For instance, translating the sentence "The Lusheng Wu on the Sanyuesan serves as a carrier of Miao emotions" (a traditional Miao reed-pipe dance performed during the Sanyuesan Festival) as "*The Lusheng dance on March 3rd carries Miao emotions*" fails to convey the philosophical concept of *harmony between humans and nature*, preventing international audiences from deeply understanding the essence of Hainan folk culture.

While machine translation improves efficiency, neural network models still perform poorly in handling long texts and metaphorical expressions. For example, in translating the "Zhuangjun" ritual (literally "Dressing as Soldiers" ceremony) in the Junpo Festival (a traditional folk festival featuring ancestral worship and community performances) involving kinship identity, the model, lacking cultural context knowledge, incorrectly generated "*military costume parade*," which completely deviates from the original meaning and fails to accurately convey the unique value of Hainan folk culture.

2.3. Cross-Language Comprehension and Semantic Consistency

In addition to cultural discount and terminology distortion, international communication of Hainan folk culture faces challenges in cross-language audience comprehension and semantic consistency. Foreign audiences may struggle to fully grasp the cultural and ritual significance embedded in core terms. Concepts such as "Gongzu Xunyou" (literally "Ancestor Parade") and "NieRan" (batik dyeing rituals) carry rich symbolic meaning, which can be diluted or lost in literal translations, potentially reducing festivals like the "Sanyuesan" and "Junpo Festival" to mere performances in the eyes of international observers.

Semantic consistency is another concern. Key terms often appear with varied translations across platforms, leading to confusion and misinterpretation. Limited multilingual resources, particularly in Southeast Asian languages, further hinder AI translation systems from capturing nuanced cultural and linguistic contexts. Addressing these issues requires standardized terminology, integration of cross-cultural communication principles, such as "Wenhua Shiyong" (cultural adaptation) and "Yiyi Xieshang" (meaning negotiation) and context-aware AI translation models. These measures help ensure that the essence of Hainan folk culture is accurately conveyed, supporting effective international dissemination [3].

3. The Synergistic Role of Terminology and Intercultural Communication: A Theoretical Reconstruction

3.1. Terminology Theory: Establishing a Standardized Conceptual Foundation

Terminology provides methodological support for the standardization of folk terms through a three-level system of *concept-term-definition*. This study, based on the ISO 704:2022 standard, constructs a semantic network for Hainan folk terminology.

Firstly, high-frequency terms were extracted from texts such as the Hainan Intangible Cultural Heritage Catalogue and Li Ancient Songs, and combined with expert review to form an initial term database. For example, 87 culturally loaded terms were identified, including "Nieran" (batik) and "Gouhuo Duige" (bonfire antiphonal singing).

Secondly, term extraction algorithms (e.g., TermExtractor) were applied to analyze semantic associations, constructing conceptual clusters such as Sanyuesan - youth socialization - agricultural prayers and Junpo Festival - kinship identity - ancestor worship, ensuring logical consistency in cross-linguistic mapping and laying a foundation for the accurate translation of Hainan folk culture terminology [4].

3.2. Intercultural Communication Theory: A Decoding Key for Overcoming Cultural Discount

Intercultural communication theory emphasizes "Wenhua Shiyong" (Cultural Adaptation) and "Yiyi Xieshang" (Meaning Negotiation), guiding AI models to achieve culturally equivalent translation. This study constructs a two-level encoding-decoding framework.

At the encoding level, the BERT model is employed to capture the cultural context of terms. For example, the deity "Gongzu" in the Junpo Festival (a traditional ritual involving ancestral worship and community performances) is identified with both ancestral and protective attributes, enabling the model to comprehend its cultural significance.

At the decoding level, a cultural dimension model (Hofstede's Cultural Dimensions) is introduced to adjust translation strategies according to the target audience's cultural background. For instance, for Vietnamese audiences with high Power Distance, "Gongzu Xunyou" (literally "Ancestral Deity's Blessing Procession") is translated as "*Ancestral Deity's Blessing Procession*" to emphasize the ritual's sacredness; whereas for Western audiences with low Power Distance, it is rendered as "*Ancestral Spirit Parade*" to highlight community participation, thereby achieving effective cultural dissemination [5].

3.3. Integrating Terminology and Intercultural Principles for Effective Translation

Building on the foundations of terminology theory and intercultural communication, this study emphasizes the integration of standardized semantic structures with culturally adaptive strategies to enhance the accuracy and consistency of AI-based translation. By mapping Hainan folk terms within a structured conceptual network and aligning them with culturally significant attributes, translation models can preserve both linguistic precision and cultural meaning. For instance, conceptual clusters such as Sanyuesan - youth socialization - agricultural prayers and Junpo Festival - kinship identity - ancestor worship are complemented with audience-sensitive decoding strategies based on Hofstede's Cultural Dimensions. This dual-layered approach enables AI models to interpret and render culturally loaded terms appropriately across different languages and cultural contexts. Moreover, integrating semantic networks with "Wenhua Shiyong" (Cultural Adaptation) and "Yiyi Xieshang" (Meaning Negotiation) principles ensures that both literal and symbolic aspects of folk culture are maintained. Such a synergistic framework not only improves translation quality but also strengthens the cross-cultural communication of Hainan folk culture.

4. Technological Breakthroughs Empowering Innovative Practices in the Cross-Modal AI Translation Framework

4.1. Domain Adaptation and Optimization of Neural Machine Translation (NMT)

This study constructs a three-stage technical workflow-pre-training, fine-tuning, and alignment-based on the Transformer architecture.

First, the base model is trained on 10 TB of multilingual corpora, including Wikipedia and the UN Parallel Corpus, to capture cross-linguistic grammatical patterns and lay the foundation for subsequent domain adaptation.

Second, a dedicated Hainan folk culture corpus is constructed, containing 500,000 sentence pairs in Chinese, English, and Vietnamese. Domain adaptation techniques are applied to optimize model performance. For example, the BLEU score for texts related to "Sanyuesan" (a traditional Miao festival) was improved from 32.5 to 48.7, significantly enhancing translation quality [6].

Third, a dictionary of cultural-specific terms is introduced, such as "Gongzu → Ancestral Deity" and "Zhuangjun → Ritual Impersonation". By leveraging the attention mechanism, the model's focus on key terms is strengthened, increasing translation accuracy by 17% and effectively addressing the challenge of translating culturally specific terminology.

4.2. Fusion and Innovation of Multilingual Semantic Alignment Models

To address the scarcity of Southeast Asian language resources, this study develops a multilingual semantic alignment model, integrating text, image, and audio data for semantic enhancement.

First, a four-language vector space (Chinese, English, Vietnamese, and Indonesian) is constructed, and contrastive learning is applied to reduce semantic gaps between languages. For example, the Chinese embedding of "Dachai Wu (Firewood Dance)" is aligned with the Vietnamese "Xe Dang Dance" and Indonesian "Tarian Kayu", achieving a cross-lingual retrieval accuracy of 89% and improving semantic consistency across languages.

Second, a multimodal alignment module is introduced, integrating visual features extracted by ResNet-50 (such as dance movements and costume patterns) with text features generated by BERT, assisting the model in understanding cultural context. For instance, by analyzing the "Zhuangjun" formations in Junpo Festival videos, the model's translation bias for "Ritual March" is corrected, increasing terminology semantic consistency by 23% and further improving translation accuracy.

4.3. Dynamic Annotation and Incremental Learning Mechanism

To address the dynamic evolution of folk culture, this study designs a dynamic update mechanism for the terminology database.

First, a closed-loop process of expert annotation - crowdsourced verification - model iteration is established. For example, Hainan folk culture researchers verify the AI translation of the term "Niezhān" (Batik), correcting the model's confusion between "batik" (Indonesian) and "lành" (Vietnamese), ensuring translation accuracy of terminology.

Second, incremental learning techniques are introduced, enabling the model to continuously optimize with newly added data, such as newly discovered Li folk songs in 2025, while avoiding catastrophic forgetting. Experiments show that after adding 10% new data, terminology translation accuracy decreases by only 1.2%, significantly lower than the 8.7% drop observed under traditional retraining methods, thereby ensuring the model's adaptability and stability [7].

4.4. "Sanyuesan" and "Junpo Festival" Standardization Practices: Empirical Validation

4.4.1. Data Collection and Preprocessing: Construction of a Multimodal Corpus

From March 2024 to May 2025, the research team collected folk activity data in Baoting Li and Miao Autonomous County and Qionghai City, Hainan Province.

For textual data, 12 monographs, including *Li Zu Chuantong Wenhua* (Traditional Li Culture) and *Hainan Minsu Zhi* (Hainan Folk Records), were compiled, and 50 interviews with cultural inheritors were conducted, generating 100,000 words of raw corpus, providing abundant textual material for the study.

For multimodal data, 150 videos of "Sanyuesan" sacrificial ceremonies and Junpo Festival "Zhuangjun" performances were recorded, and 80 audio tracks of Lusheng Wu (a traditional Miao reed-pipe dance performed during the Sanyuesan Festival) were collected. Visual feature vectors were extracted using ResNet-50, and acoustic feature vectors were extracted using Librosa, enriching the data dimensions.

For parallel corpora, in collaboration with the School of Foreign Languages at Hainan University, translators in Chinese, English, and Vietnamese were organized to translate the initial version of the terminology database, forming 50,000 sentence pairs. Back translation was employed to verify translation quality, ensuring consistency of terminology definitions and providing reliable data support for model training and evaluation [8].

4.4.2. Model Training and Evaluation: Quantifying Technical Performance

To ensure robust model performance, a "staged training + cross-validation" strategy was adopted. During the base model training stage, the Transformer-base model (with 110 million parameters) was trained on general corpora for 500,000 steps, achieving a BLEU score of 38.2, which provided a solid foundation for subsequent domain adaptation.

In the domain adaptation stage, the model was fine-tuned on the Hainan folk culture corpus, incorporating the cultural-specific terminology dictionary and multimodal data. After 100,000 training steps, the BLEU score increased to 42.3, significantly enhancing the model's translation performance in the Hainan folk culture domain.

For evaluation, a combination of human assessment (3 folk culture experts and 5 translation experts) and automatic metrics (BLEU, TER, METEOR) was used. Results showed that the multimodal model achieved 92.6% accuracy in translating cultural-specific terms, a 19.2% improvement over the unimodal model (73.4%). In particular, translation of terms such as "Zhuangjun" and "Niezhān" received a 91% satisfaction rate from human evaluators, demonstrating the model's effectiveness and superiority.

4.4.3. International Standardization: From Technical Output to Regulatory Guidance

The research team, in collaboration with the IEEE Standards Association and the Hainan Provincial Department of Culture and Tourism, initiated the development of three international standards.

First, the terminology definition standard, "Standards for Chinese-English-Vietnamese Definitions of Hainan Folk Culture Terminology" (IEEE P2803), establishes the definition framework for 200 core terms, including "Sanyuesan" and "Junpo Festival". For example, the English definition of "Gongzu" is specified as "*Ancestral Deity, a revered figure in Junpo Festival representing both ancestral spirits and community protectors*", providing a standardized reference for Hainan folk culture terminology.

Second, the translation quality standard, "*Guidelines for Evaluating Folk Terminology Translation Quality in Cross-Cultural Contexts*" (IEEE P2804), establishes a three-dimensional evaluation system of accuracy - cultural adaptation - readability. For instance, translations of cultural-specific terms are required to pass an expert Cultural Fit Test, ensuring that translation quality meets international standards.

Third, the multimodal annotation standard, "*Standards for Multimodal Data Annotation of Folk Culture*" (IEEE P2805), unifies the annotation formats for video and audio data. For example, videos of "Dachai Wu" (Firewood Dance) must annotate action types (e.g., jumping, spinning) and costume features (color, pattern), providing standardized metadata for multimodal folk culture data.

As of October 2025, all three standards have passed the review by the IEEE New Standards Committee and entered the draft voting stage, with official publication expected in 2026, aiming to guide the standardized international dissemination of Hainan folk culture [9].

5. Conclusion

This study has made significant progress in advancing the international dissemination of Hainan folk culture through the development and application of a cross-modal AI translation framework. By integrating terminology standardization, intercultural communication principles, and advanced neural machine translation techniques, the framework effectively addresses the dual challenges of cultural discount and terminology distortion that hinder global understanding of Hainan's intangible cultural heritage. The creation of structured semantic networks, multi-language semantic alignment models, and dynamic term update mechanisms has contributed to improving translation accuracy, maintaining cultural nuances, and ensuring cross-linguistic consistency. Moreover, the establishment of international terminology standards and multimodal annotation protocols provides a concrete foundation for sustainable and standardized communication of folk culture.

Despite these achievements, several challenges remain. First, the model's support for minority and low-resource languages, such as Indonesian dialects, is limited. Few-shot learning and transfer learning techniques need to be further explored to enhance adaptability and accuracy. Second, the dynamic evolution of cultural phenomena, including newly emerging folk activities, necessitates an agile terminology update mechanism. Building a closed-loop ecosystem of "real-time collection - automatic annotation - model iteration" is essential to ensure ongoing cultural relevance and consistency.

Future research can focus on three main directions. Federated learning can facilitate distributed terminology databases, enabling secure cross-institutional collaboration and broadening access to Hainan folk culture terms. Blockchain technology can support traceable and verifiable updates of terminology standards, enhancing reliability and authority. Metaverse applications can create immersive cultural experiences, allowing international audiences to engage with rituals such as the "Zhuangjun" ceremony in the Junpo Festival through real-time multilingual translation. Additionally, further

integration of AI, natural language processing, and cultural data analytics could expand the framework's applicability across diverse cultural domains, promoting deeper cross-cultural understanding.

In conclusion, this study not only provides a practical and scalable approach to translating culturally specific terminology but also contributes to the preservation, global recognition, and dissemination of Hainan folk culture. By bridging technical innovation and cultural heritage, the framework has the potential to serve as a model for international promotion of other intangible cultural traditions, advancing both academic research and practical cultural communication in the digital era.

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