# AI-Driven Machine Translation and Human Creativity: A Collaborative Model for the Future

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_Abstract— With the rapid development of artificial intelligence (AI) and neural machine translation (NMT) technology, the translation industry is undergoing a profound transformation. AI excels at processing standardized texts quickly and maintaining terminology consistency. However, in areas such as emotional expression, cultural nuance, and literary translation, AI still faces significant limitations. This paper explores future collaboration models between human translators and AI, particularly in post-editing, cultural adaptation, contextual understanding, and emotional conveyance. By combining human creativity with AI's efficiency, higher-quality translations can be achieved. In the future, human translators will take on roles as cultural mediators and creative translators, providing flexible and deep solutions for complex cross-cultural translation tasks through collaboration with AI._

_Keywords— machine translation; human translation; human-AI collaboration_

## I. INTRODUCTION

Machine translation (MT) is the process of using computers to convert a source language into a target language. research in machine translation focuses on utilizing computers to achieve automatic translation between natural languages and is one of the significant research directions in artificial intelligence and natural language processing (Liu Yang, 2017). The development of artificial intelligence is generally characterized as a progression from mechanical learning to machine learning (Yin Fenglin & Zhao Yixin, 2021). In general, machine translation can be divided into four stages: rule-based machine translation, statistical machine translation, example-based machine translation, and machine translation based on different application methods (Hu Kaibao & Li Yi, 2016).

The development of machine translation has spanned several decades, reflecting the powerful driving force of deep learning algorithms behind AI technology. In the 1950s, machine translation was first proposed, with early systems relying on preset grammar rules and dictionary-based translations. However, this approach was too rigid to handle the complexities of linguistic context. In the 1990s, the rise of statistical machine translation (SMT) brought a significant improvement in translation efficiency and accuracy by analyzing large bilingual corpora. Yet, SMT still faced limitations in dealing with complex syntax and semantic consistency. Entering the 21st century, the

advancement of deep learning technologies led to the emergence of neural machine translation (NMT). By simulating the human brain's language processing through neural networks, NMT has made translation more natural and fluent, excelling particularly in long sentence processing and contextual understanding.

Despite the significant progress of NMT in translation speed and accuracy, it still encounters challenges in handling complex content such as cultural context, metaphors, and emotional expression. This provides a new opportunity for collaboration between human translators and AI, highlighting how human creativity and cultural sensitivity can further enhance translation quality on top of AI-generated translations. This paper explores the collaborative model between AI and human translators in the translation process and suggests potential workflow transformations for the future translation industry.

## II.    THE PROGRESS AND LIMITATIONS OF MACHINE TRANSLATION

In recent years, the rapid development of Neural Machine Translation (NMT) technology has brought significant transformations to the translation industry. NMT leverages deep neural networks, learning from large-scale bilingual corpora, to efficiently handle complex linguistic structures, thereby significantly improving the fluency and accuracy of translations. AI systems such as Google Translate and DeepL have demonstrated clear advantages in translating technical documents, standardized texts, and news reports. By accurately capturing sentence structures and semantic relationships, these systems can generate translations that better align with the norms of the target language.

The core strength of NMT lies in its self-learning capability, which allows it to process long and complex sentence structures more effectively through extensive data training. This technological advancement not only enhances translation efficiency but also increases the practical value of machine translation in real-world applications. For instance, in translating specialized documents in fields such as law and medicine, NMT ensures consistency and accuracy in terminology, which is difficult to achieve

through traditional translation methods.

However, despite its strong performance in handling standardized texts, NMT exhibits significant limitations when it comes to literary translation, emotional expression, and cultural nuances. Machine translation often struggles to grasp and reproduce the subtle emotions and cultural connotations embedded in literary works. For example, metaphors, puns, and colloquialisms are frequently misunderstood or directly translated by machine translation, leading to a loss of richness and depth in the translated text. These limitations not only affect the quality of the translation but may also result in the target audience misinterpreting the text.

Additionally, the limitations of machine translation are also evident in its inadequate sensitivity to context. Many expressions in language rely heavily on specific cultural and situational contexts, which NMT often finds difficult to handle. When translating texts that contain regional characteristics or cultural symbols, machine translation tends to fail in capturing these specific cultural meanings, resulting in translations that lack cultural adaptability.

"Although the currently popular NMT systems have made considerable progress, with a certain capacity to simulate the internal structure of human language, their ability to simulate the external world as well as social and historical contexts remains quite limited. In essence, the intelligence possessed by NMT is not yet equivalent to fully developed human intelligence but rather a rudimentary stage of human-like intelligence" (Feng Zhiwei & Zhang Dengke, 2022).

## III.    THE ADVANTAGES OF HUMAN TRANSLATORS

Despite the significant progress made by machine translation, it still falls short when dealing with certain types of texts, such as literary works, highly specialized texts, and advertising slogans. In these cases, human translators become indispensable.

**(1) Handling Cultural Differences in Machine Translation vs. Human Translation**

Cultural differences play a crucial role in determining the effectiveness of a translation. Every language is

embedded within a unique cultural background and historical context, elements that cannot simply be conveyed through word-for-word translation. For instance, certain idioms, proverbs, historical allusions, and religious symbols in the source text may be completely unfamiliar to readers from the target culture or may carry entirely different connotations. In such cases, direct translation could lead to misunderstandings or result in a loss of the text's original flavor.

In the following section, the author will examine the shortcomings of machine translation when handling cultural differences, using two of the most popular translation engines, Baidu Translate and DeepL, as examples. This analysis will highlight the importance of human translators in dealing with such sentences and texts.

Example 1:

例 1：

Source text：He's all hat and no cattle.

Translation (Baidu Translate)：他只戴帽子，没有牲畜。

Translation (DeepL)：他只会戴帽子，不会放牛。

Human translation：他光说不练。

He's all hat and no cattle is an idiom originating from the American West, meaning someone who is "full of talk that is more impressive than what one actually possesses or is able to do." In the American West, cowboys typically wear large hats as symbols of their identity and status. However, owning cattle is the true mark of a cowboy's identity and success. Thus, this phrase suggests that a person may dress like a cowboy (hat), but without actual cattle (representing real power or capability), their image is hollow and pretentious. As can be seen, machine translation struggles with this idiom, often rendering it as a literal translation without conveying its true underlying meaning. In such cases, human translators are needed to conduct research and revise the translation to ensure it accurately reflects the idiomatic meaning.

**(2) Emotional Expression in Machine Translation vs. Human Translation**

While machine translation excels in terms of speed and efficiency, it faces significant limitations when conveying emotional expression. Machine translation tools typically rely on literal translation, failing to fully grasp the emotional nuances present in the context, which leads to the loss of emotional content. For example, when translating sentences with sarcasm or humor, machine translation often fails to recognize the underlying emotional tone and may interpret the sentence literally, resulting in a distorted translation. This lack of contextual awareness makes machine translation inadequate for handling complex emotional and cultural content. To illustrate this, the author will analyze the subtitles of the American sitcom The Big Bang Theory in China, showcasing the shortcomings of machine translation in emotional expression and the unique advantages of human translators in this aspect.

Example 2：

Source text：

Sheldon: You know, I am very disappointed that I won't be able to celebrate Howard's accomplishment tonight.

Amy: Me, too. But we'll see him tomorrow.

Sheldon: Yes, it's just that in all the years I've known him, he's never had the opportunity to receive my admiration. I was excited to see the look on his face when it finally happened.

**Penny: You're unbelievable.**

**Sheldon: I know.**

Lenard: All right, Pictionary, what are the teams?

Penny: How about boys versus girls?

Sheldon: Oh! That hardly seems fair. But I guess any team that I'm not on has a decided disadvantage.

**Penny: Once again, unbelievable.**

**Sheldon: Once again, I know.**

Machine translation (Baidu Translate)：

谢尔顿：你知道吗，我很失望今晚不能庆祝霍华德的成就。

艾米：我也是。但我们明天会见到他。

谢尔顿：是的，只是在我认识他的这些年里，他从来没有机会得到我的钦佩。当事情最终发生时，我很高兴看到他脸上的表情。

**佩妮：你真是难以置信。**

**谢尔顿：我知道。**

莱纳德：好的，Pictionary，有哪些团队？

佩妮：男孩和女孩怎么样？

谢尔顿：哦！这似乎不太公平。但我想任何我不在的球队都有明显的劣势。

佩妮：再一次，难以置信。

谢尔顿：我知道了。

Machine translation (DeepL)：

谢尔顿：知道吗，我很失望今晚不能为霍华德的成就庆祝了。

艾米：我也是。不过我们明天就能见到他了。

谢尔顿：是的，只是我认识他这么多年，他从来没有机会接受我的钦佩。我很想看看他脸上的表情。

佩妮：你真是不可思议。

谢尔顿：我知道。

莱纳德：好吧，猜字游戏，有哪些队伍？

佩妮：男生对女生怎么样？

谢尔顿：哦！这似乎不太公平。但我想，我不在的队伍肯定处于劣势。

佩妮：又一次难以置信

谢尔顿：我知道。

Human translation（by Fansup group）：

谢尔顿：我好失望哦，今晚不能给霍华德庆祝他的成就。

艾米：我也是，但明天就能见他啦。

谢尔顿：只是我认识他的这些年来，他从未有机会得到我的赞赏。本来还期待看他得到赞赏时脸上那表情呢。

佩妮：你真是奇葩。

谢尔顿：人中龙凤是谓奇葩。

莱纳德：你画我猜，怎么分队？

佩妮：男女分队如何？

谢尔顿：这会不会不太公平，我加入任何一队都是对其他队伍的不公平。

佩妮：再次觉得你奇葩。

谢尔顿：再次回应你，鹤立鸡群是谓奇葩。

Subtitle translation is crucial to the dissemination of films and television shows. A well-done subtitle translation not only enhances the audience's immersion but also provides a better aesthetic experience. The example above is taken from the opening scene of Season 6, Episode 4 of The Big Bang Theory. In this scene, Howard returns to Earth after completing his space mission, while Sheldon, Amy, Leonard, and Penny prepare to play a game of Pictionary in the apartment. The key points of the dialogue

are highlighted. Both "unbelievable" and "I know" were translated literally by machine translation, while human translators performed much better in comparison.

Firstly, translating "unbelievable" as "奇葩" (qí pā, meaning "eccentric" or "odd") is directly related to Sheldon's character. Due to his extraordinary intelligence, Sheldon often appears different from others. He is meticulous, insists on following strict routines, lacks understanding of humor or sarcasm, and often flaunts his intelligence—something that frequently annoys the other characters. This trait is also a key source of humor in the show. "Unbelievable" typically means "incredible" or "amazing," but in this context, it carries a touch of sarcasm. Therefore, the subtitle team translated it as "奇葩," which both fits the context and adds a humorous element.

The most impressive part, however, lies in the handling of the two instances of "I know." Unlike the literal translation provided by machine translation, the subtitle team used an explanatory approach to interpret "奇葩." For the first "I know," the team translated it as "人中龙凤是谓奇葩，" which means "an extraordinary person, a true oddity." For the second "I know," the subtitle team opted for another metaphor: "鹤立鸡群," meaning "a crane standing among chickens," to indicate someone who stands out from the crowd due to their exceptional qualities. These translations fit Sheldon's personality, while also making the humor clear to the audience. Sheldon's lack of understanding of sarcasm led him to respond with "I know," and the use of "人中龙凤" and "鹤立鸡群" reflects his self-confidence and tendency to boast about his intelligence. This level of understanding of the plot, character development, and emotional nuance is something machine translation currently cannot achieve, underscoring the irreplaceability of human translators.

**(3) Creativity in Machine Translation vs. Human Translation**

Translation is a creative activity, and one of the areas where creativity is most required is in advertising translation. In the global market, advertising translation is vital, as it not only involves converting content from one language to another but also ensuring that the message aligns with the target market's culture and customs.

Effective advertising translation can enhance brand image, maintain consistency across different markets, and reflect the characteristics of the local culture. This cultural adaptation fosters a sense of connection and familiarity among consumers. Additionally, advertising translation directly impacts market competitiveness. As businesses expand into international markets, the quality of advertising translation can determine the success of marketing efforts. Successful advertising translation helps brands stand out among competitors, thereby driving sales growth. Next, the author will compare Apple's official website in China with its U.S. counterpart to examine how machine translation performs in advertising translation and compare it with human translations.

Example 3:

Official website (US) original text: So fast. So fluid. Get a feel for the all-new Camera Control.

Machine translation (Baidu Translate): 这么快。如此流畅。感受一下全新的相机控制。

Machine translation (DeepL): 如此快速。如此流畅。感受全新的相机控制功能。

Official website (China) target text: 又快又顺手，全新相机控制功能超带感。

Example 4:

Official website (US) original text: Customize. Stylize. Mesmerize.

Machine translation (Baidu Translate): 定制。风格化。令人着迷。

Machine translation (DeepL): 定制。风格化。让人着迷。

Official website (China) target text: 可定制，有风格，着迷就对了。

Example 5:

Official website (US) original text: Lock in your look.

Machine translation (Baidu Translate): 锁定你的外观。

Machine translation (DeepL): 锁定你的造型。

Official website (China) target text: 锁定你的美一面。

The primary characteristic of advertising is its commercial nature. Advertising is a competitive activity aimed at persuading potential buyers, making the buyer the focal point of their work. Advertisers capture consumers'

attention, cultivate their interest, stimulate their desire, and ultimately lead to purchasing behavior. The same applies to advertising translation. Therefore, when translating advertisements, catering to consumer satisfaction is more important than anything else. Sometimes, entertainment is also necessary. A good advertisement translation should be natural, easy to understand, precise, and appealing (Shuna, 2014). Advertising translation requires the translator to fully mobilize their creativity, using concise and attractive language to promote and drive consumption.

As seen in the examples above, machine translation falls far short of human translators in terms of creativity, linguistic conciseness, and appeal. First, when faced with translating individual words into sentences, machine translation opts for a direct, word-for-word approach, while human translators transform them into short phrases. In Example 4, all machine translations rendered it as "Customize. Stylize. Mesmerize." in three separate sentences. In contrast, human translators fully utilized their creativity, combining the three individual words into a complete sentence: "可定制，有风格，着迷就对了". This translation not only avoids a sense of disconnection but also flows smoothly, clearly showcasing the product's features.

In Example 5, the human translator cleverly used a homophone in Chinese, changing "每" (every) to "美" (beautiful), which not only highlighted the camera's function but also cleverly appealed to female consumers, achieving the goal of promoting the product.

Successful advertisements often rely on emotional resonance, and human translators can flexibly adapt the content according to the cultural customs of the target market, thereby enhancing the brand's appeal. In contrast, machine translation frequently struggles to capture these subtle cultural differences, leading to distortions in the translated text. Additionally, advertising language is highly creative, filled with metaphors and elements of humor, all of which require human creativity for skillful handling. Human translators can not only accurately convey emotions but also continuously refine translations based on market feedback, improving the effectiveness and acceptance of the advertisements. Therefore, in the process of translating advertisements, the role of human translators remains

irreplaceable by machine translation.

## IV.    COLLABORATIVE MODELS FOR HUMAN AND AI TRANSLATION IN THE FUTURE

In the future, there are two key aspects worth noting in the collaborative model between human and AI translation. First, AI will take on the task of initial translation, efficiently processing large volumes of standardized texts to improve productivity, thereby allowing human translators to focus on more complex tasks, such as cultural adaptation and emotional expression. Second, as AI technology continues to evolve, the role of translators will shift towards becoming more creative and strategic cultural mediators. They will perform in-depth revisions and optimizations based on AI-generated translations to ensure the final output is both accurate and culturally appropriate. This human-AI collaboration model will push the translation industry towards greater efficiency and flexibility, better meeting the demands of the globalized market. The author will now explore two models of human and AI collaboration in translation.

### (1) Post-Editing

As technology continues to advance, human-machine collaboration has become the mainstream working model in many fields, and the translation (language services) industry is no exception. The combination of machine translation and human translation has already become a dominant working mode (Fan Zirui & Yang Wendi, 2024). "Although machine translation technology has made significant progress, the overall quality still needs improvement and is not yet at a level where it can fully replace human translators" (Wang Huashu & Chen Niao, 2021). This is particularly true for literary works. When translating literary texts, an initial translation can be done using machine translation, followed by human translators revising and refining the machine-generated content to enhance readability. This process can improve efficiency and save time. The following is an example of collaboration between machine translation and human translators.

Example 6：

Source text："Ze great Beess-he stan' up-he beat his bres' wiz hees beeg feests-he roar—I shoot—CRASH! He fall dead at my feet-I have keel my gorilla."

Machine translation: "伟大的比斯——他站了起来——他打败了他的兄弟，他用脚踢了他的兄弟——他咆哮——我开枪了——崩溃！他倒在我脚下死了——我已经把我的大猩猩弄倒了。"

Human translation: 那个巨型野兽站起来了，拍打着胸脯，跑得飞快，大声咆哮，我开枪了干掉了它，它就死在我脚边，我杀死了那个大猩猩。

The excerpt above is from Charles Knight's Life Through the Ages, a beautifully written account of the evolutionary journey of prehistoric animals. The original dialogue carries distinctive accents and a dramatic tone, but machine translation rendered it stiff and overly detailed, making the sentences less fluent. In contrast, the human translation simplified the dialogue by turning "the great Beasts" into "that giant beast," removing redundant details and improving the narrative's coherence, making the sentences more concise and easier to understand.

Additionally, the human translation omitted overly colloquial and repetitive details from the original, such as "he defeated his brother," which lacks substantive information. Instead, phrases like "pounding its chest, running fast, and roaring" were used to retain the fierce image of the beast while making the expression more vivid and natural, in line with Chinese narrative style. Finally, "I shot it dead" directly conveys the action's result, enhancing the narrative's rhythm and tension, fitting the dramatic scene.

This illustrates that while Neural Machine Translation (NMT) technology is highly efficient in handling standardized texts, it often fails to capture and convey the essence of original literary works, particularly their complex emotions, cultural metaphors, and stylistic nuances. Literary works rely not only on literal translation but also on a deep understanding of emotional depth, cultural context, and authorial intent. Through meticulous post-editing and cultural adaptation, human translators ensure that translated works are both fluent and artistic, making the translation accurate in language and emotionally resonant. Furthermore, translators can adjust the translation according to the cultural habits of the target audience, using expressions that better resonate with readers, thereby

enhancing the work's acceptance and impact. Studies show that when translating classic literary works, the creativity and judgment of human translators are key factors in ensuring translation quality, a task that machine translation cannot fully replace.

**(2) Augmented Translation**

Augmented translation, first introduced by the Common Sense Advisory (CSA), is a concept that refers to the enhanced collaboration between human translators and machine translation tools. CSA is a renowned consulting firm specializing in research on the language services, translation, and localization industries. It provides market research, industry trends, data analysis, and consulting services to the translation and localization sectors. According to CSA's official website "Augmented translation is a new approach to combining the strengths of humans and machines to address growing needs for multilingual content. In contrast to traditional post-editing, which leaves translators at the end of a process and asks them to clean up garbage machine translation (MT) output, augmented translation places linguists at the center of a constellation of technologies that support them and extend their capabilities: enhanced translation memory, adaptive neural machine translation, automated content enrichment, next-generation terminology management, lights-out project management, and microservices-based translation management systems. The results increase the productivity and value of human linguists by providing relevant information and letting them focus on those aspects of translation that require their attention".

Augmented translation's real-time feedback mechanism optimizes translation quality by integrating human translators with AI in an interactive environment. In this model, AI generates an initial translation, and human translators then perform immediate revisions and corrections within an interactive translation system. The machine learning model records these adjustments and learns from them, gradually adapting to the translator's language style and cultural preferences. Through the real-time updating of translation memory, AI can provide more accurate translation suggestions in future similar tasks, significantly improving translation consistency and

adaptability. This human-AI collaboration enables augmented translation to strike a balance between speed and quality, delivering efficient and precise translation outputs.

## V. CONCLUSION

AI-driven Neural Machine Translation (NMT) technology is rapidly transforming the landscape of the translation industry, and the collaborative model between human translators and AI will be a key trend in future translation practices. AI excels in handling standardized texts and improving translation efficiency, particularly in large-scale, repetitive, and terminology-heavy content, where machine translation can significantly boost productivity. However, human translators continue to have irreplaceable advantages in areas such as emotional expression, cultural adaptation, and creative reproduction. AI still falls short when dealing with complex literary works, advertising copy, and content requiring nuanced cultural understanding.

Through collaborative models like augmented translation or post-editing, human translators and AI complement each other, each playing to their strengths to achieve efficient and high-quality translations. In the augmented translation model, AI generates the initial translation, while human translators perform real-time revisions and edits to ensure high standards in cultural adaptability and emotional expression. In the post-editing model, human translators deeply review and adjust AI-generated texts to ensure that the language is natural, fluent, and culturally appropriate for the target audience. This cooperative model not only greatly improves translation efficiency but also preserves and enhances the quality and cultural depth of the translated content.

In the future, the role of translators will focus more on cultural mediation and creative tasks. They will take on greater responsibility for cultural adaptation and emotional expression, using precise language choices and deep understanding of the source text to ensure that translations resonate emotionally and are culturally relevant to the target readers. Moreover, the collaboration between human translators and AI will address increasingly complex cross-cultural translation tasks, providing high-quality language

services to audiences from diverse cultural backgrounds. This collaborative model not only drives the translation industry towards higher quality and deeper levels of work but also strengthens the bond between humans and AI, enabling them to complement each other's strengths and jointly expand the depth and breadth of translation.

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