Automation and Machine Learning (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/autml.2023.040201
ISSN 2516-5003 Vol. 4 Num. 2

Computer Aided Foreign Language Translation Optimization Algorithm Based on Human-computer Interaction

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Keywords: Human Computer Interaction, Computer Aided, Foreign Language Translation, Optimization Algorithm

Abstract: Machine translation technology has made great progress in the past few decades, especially the proposal of statistical machine translation technology. If the meaning of the translation can be roughly understood in a limited field of some specific languages, it can be said that it has not reached the level of correctly expressing the meaning of the original text in all fields of all languages. Computer assisted translation technology has been widely developed as a viable alternative to machine translation. Interactive machine translation technology is one of the feasible models. In order to verify the feasibility of computer-aided translation in foreign language translation, this technology has been widelyused. Optimization algorithm based on human-computer interaction, this paper tests the translation accuracy and speed of computer-aided foreign language translation and traditional translation under different sentences (words, phrases, sentences, paragraphs). The test results show that the translation accuracy of computer-aided foreign language translation optimization algorithm based on human-computer interaction is higher than that of traditional translation under words, phrases, sentences and paragraphs, and the translation accuracy is more than 96%, while the highest accuracy of traditional translation is only 94.38%; In terms of translation speed, human-computer interaction translation is still faster, reaching 4.41 sentences / second. It fully proves the superiority and feasibility of the translation optimization algorithm proposed in this paper.

1. Introduction

Computer-aided translation technology is not only a new thing for translators, because diversified and comprehensive computer-aided translation tools can make the best use of language and cultural assets, improve the quality of translation, and save a lot of translators' time. Therefore, this paper next discusses the optimization algorithm of computer-aided foreign language translation based on human-computer interaction.

Optimization algorithm of computer-aided foreign language translation based on human-computer interaction. Sarimang explored the impact of computer-assisted instruction on

word stress skills in foreign language teaching. This study adopts. The data are from the "word stress measurement tool" and students' recordings. In Praat 3.8.47 speech analysis program, the audio records obtained from students are checked and evaluated from the perspective of basic frequency to determine the success of students in word stress [1]. Kook J proposed a simple and effective method of topology optimization using advanced programming. Through the topology optimization of the acoustic structure interaction problem with mixed displacement pressure formula, the effectiveness of the proposed implementation method for multi physical problems of system design is proved [2].

Computer assisted foreign language translation is a technology that has obvious advantages over traditional manual proofreading. Firstly, computer-aided translation can significantly improve translation quality and proofreading speed, because computer-aided translation technology can help proofreaders identify and correct potential language, spelling, and grammatical errors. At the same time, computer-aided translation can ensure the consistency of terms, as it can help proofreaders find the correct translation of terms and ensure that these terms remain consistent throughout the document. Secondly, computer-aided translation can improve work efficiency because it can automate repetitive tasks such as finding, replacing, and aligning translated text. In addition, it can also provide fast translation suggestions and terminology explanations, thereby reducing the workload of proofreaders and improving translation efficiency. It can help reviewers free themselves from some minor but extremely important and often exhausting translation "small things" and ensure the quality of translation [3, 4].

2. Computer Aided Foreign Language Translation Based on Human-computer Interaction

2.1. Man Machine Interactive Translation Method Based on Word Graph

The method of using word graph to realize interactive machine translation is a very efficient method. Here is a very important concept - word graph, which is mainly used to represent all or part of the possible translations corresponding to the source language sentence. For each source language sentence to be translated, a word map should be generated for it. The system uses this word map to complete the matching of the translation prefix fed back by the translator. In other words, after the translator accepts (or modifies) the prefix string of a translation, the system will look for the candidate path with the highest score matching the prefix string in the word graph, so that the system can generate a complete target language translation according to the path (or generate an optimal target language suffix for the current translation prefix) [5]. This method uses word map as an intermediate medium to realize the interaction between machine translation engine and translators. It is very efficient because it only needs to search and decode the sentences in the source language once to generate word map, and does not need to search and decode again every time there is new feedback from users.

For a source language sentence, if no pruning processing is carried out in the generation process of its corresponding word map (i.e. the search process of translation), the generated word map will be able to represent all target language sentences with a posteriori probability greater than zero based on the used translation model [6, 7]. However, if we want to make machine translation a NP complete problem solvable, pruning technology must be used, so the final word graph can only represent a small subset of all possible translations. In this case, there may be a problem that the translation prefix fed back by the user cannot match completely (does not exist) in the word map. In order to solve this problem, some heuristic strategies are applied to the search and matching of translation prefixes.

For prefixes that cannot be exactly matched, first, we find the node with the smallest editing distance from the prefix that does not contain the last (or part) word. Then, in the subsequent part of

the node, we select a suffix starting with the last (or part) word of the prefix and having the best reverse score (probability) to complete the current translation. The so-called reverse score refers to the score corresponding to the path part from the first node of the suffix to the final node of the path. Now, new problems will arise again, because the word map generated in the initial stage may not be compatible with the new information provided by the prefix confirmed by the user. Since the last (or part) word of the prefix may not exist in the current word map, the translation of the current sentence cannot be supplemented completely. This problem is not easy to solve. Relying solely on the word map can no longer meet the requirements, so it is necessary to introduce other heuristic strategies. At present, it is mainly to use the language model of the target language to predict the current prefix with the highest probability and the completion of the last word to a certain extent. However, it is gratifying that taking the translation suffix generated by this heuristic strategy as a supplement does improve the performance of the system, this is mainly because some words deleted due to pruning strategy in the search process have been restored [8].

2.2. Application of Computer Aided Translation Software

Compared with traditional translation processes, computer assisted translation software is unique in that computers actively participate in translation work. In the preparation stage before proofreading, it is first necessary to divide the English original text and Chinese translated word document into several parts by chapter, and then use the online alignment function to create a memory library. This memory bank consists of the original text and its translation, and is imported into computer-aided translation software. Through pre translation, computer-aided translation software presents the original text and its translation, allowing for the use of computer-aided translation programs to modify word text. The workload before the revision may be somewhat large, and there may be some difficulties [9-10]. Compared to conventional methods using the word revision mode, the revision of computer-aided translation software is more convenient. When using word revision mode, you need to open the original document and the original translated document respectively, and then select "Review Revision" and "Revise" in the original translated document. "Due to the need to compare the original text with the original translation, you need to select the original document in the View and select the original file in the dialog box.". However, since the number of characters cannot be the same after English is translated into Chinese, the space occupied by words must be inconsistent, which wastes a lot of time and effort in finding the corresponding relationship between the original text and its translation. However, after using computer-aided translation software, the original text and its translation will correspond neatly to each other, without losing context, and with a simple interface. Although there may not be readily available review opinions, you can use a memory library to search for similar expressions, search for fragment reference phrases, or use fixed collocation translation methods. At the same time, you can also directly use online dictionaries to find translation methods in the network [11-12].

3. Human Computer Interaction Translation Algorithm

For the prefix letter Pt fed back by the translator to the target sentence, the purpose of the search is to obtain a more reasonable suffix translation TS based on the prefix information fed back, as shown in formula (1):

$$\hat{t}_c = \arg\max_{t_c} \Pr(t_c \mid t_p, c) \tag{1}$$

Formula (2) is obtained through Bayesian Transformation:

$$\hat{t}_c = \arg\max_{t_c} \Pr(s \mid t_p, t_c) \bullet \Pr(t_c \mid t_p) \tag{2}$$

At this time, the search space of the translation is limited to all possible translation t that meet the prefix Pt requirements. It is worth mentioning that because TPTC = t, it allows them to adopt very similar search strategies when solving, and all they need to do is make a slight adaptive change to the search strategy of machine translation.

The main significance of this research method is to provide a new idea for interactive machine translation, which not only solves the problem of using user knowledge, but also provides users with a convenient interface for understanding and interaction. At the same time, this interaction mode also provides good compatibility for the processing of unregistered words (when the translation engine cannot give the translation, it can be input directly by the user or interact with the user through other strategies). Of course, a very friendly way of interaction can also maximize the work efficiency of users.

4. Experimental Analysis of Computer-aided Foreign Language Translation Optimization Algorithm Based on Human-computer Interaction

To verify the feasibility of computer-assisted foreign language translation optimization algorithms for human-computer interaction, researchers conducted a series of tests to compare the translation accuracy of computer-assisted foreign language translation and traditional translation under different sentence lengths. These tests include the translation of words, phrases, sentences, and paragraphs, with the aim of determining the effectiveness of computer-assisted translation in different contexts. The test results show that the accuracy and consistency of computer-aided translation are significantly better than traditional translation, and can greatly improve work efficiency. The test results are shown in Table 1 and figure 1:

Table 1: Under different translation algorithms

Translation algorithm	Word	Phrase	Sentence	Paragraph
Computer aided foreign Language translation	98.71%	98.57%	97.01%	96.23%
Traditional translation	94.38%	93.12%	92.33%	90.89%

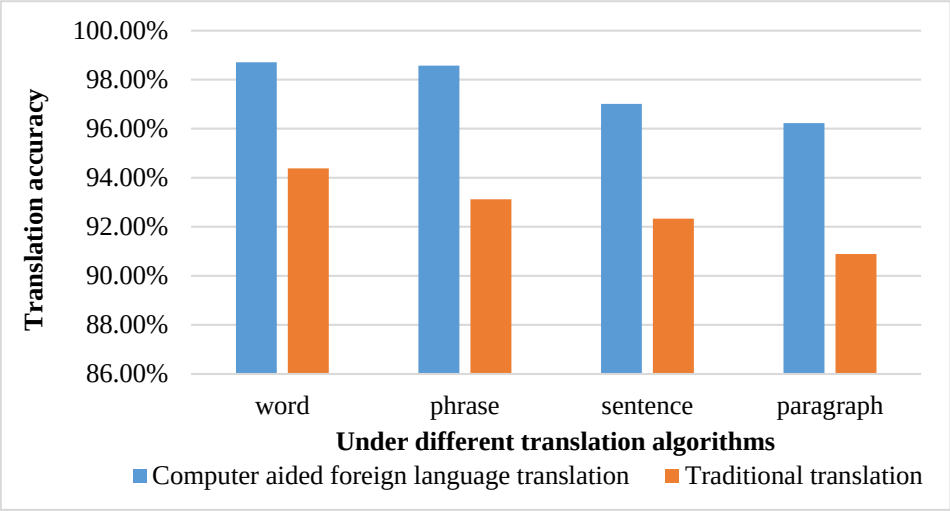

Figure 1: Under different translation algorithms

As can be seen from the above chart, the translation accuracy of computer-aided foreign language translation optimization algorithm based on human-computer interaction under words, phrases, sentences and paragraphs is higher than that of traditional translation, and the translation accuracy has reached more than 96%, while the highest accuracy of traditional translation is only 94.38%.

Another requirement of interactive machine translation - speed cannot be ignored in translation. In the process of interaction with translators, the requirement of real-time is very necessary. If the speed is too slow, the existence of the interaction process becomes unnecessary and may even become an obstacle. It should be noted that the execution speed of the translation engine is directly related to the length of the sentence to be translated, so here we tested the average decoding speed of each system on the test set, that is, the total number of times of decoding on the test set divided by the total time of decoding on the test set. Obviously, in the process of interaction, the number of words decoded for a sentence is more than once, Moreover, the length of sentences in the test set is not exactly the same? The translation speed and accuracy test are shown in Figure 2:

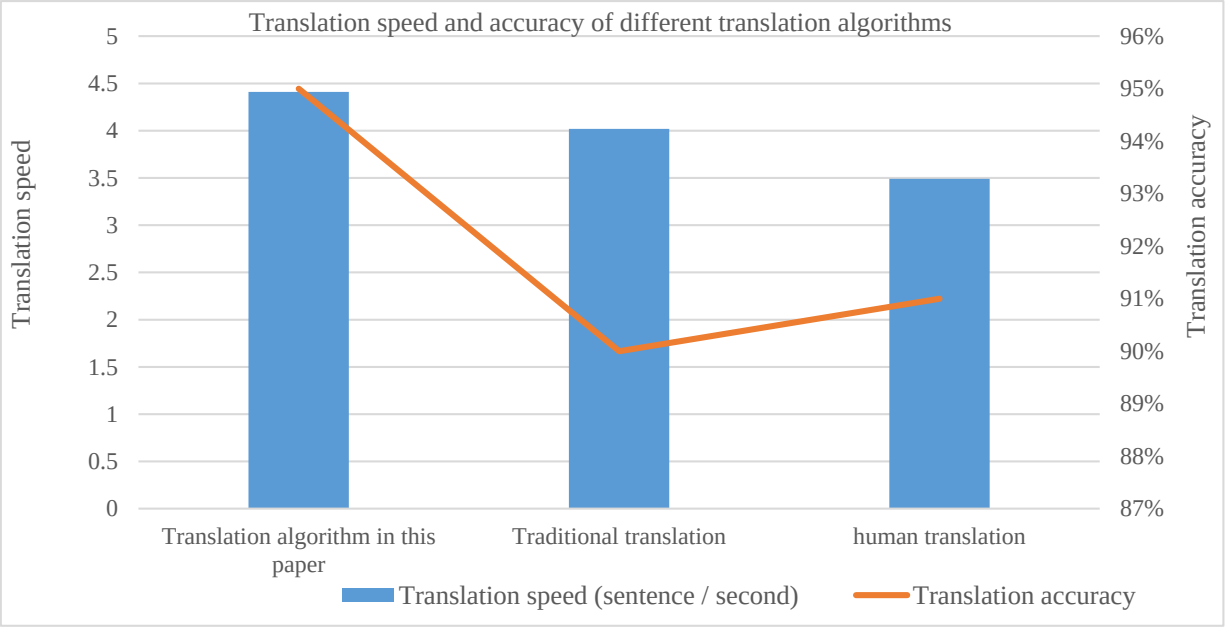

Figure 2: Translation speed and accuracy of different translation algorithms

The experimental analysis shows that in terms of translation speed, human-computer interaction translation is still faster, reaching 4.41 sentences / s, while the traditional translation speed is slightly slower. To sum up, the experimental results show that the computer-aided foreign language translation optimization algorithm based on human-computer interaction proposed in this paper has obvious advantages, both in translation speed and translation quality.

5. Conclusions

In the short term, the focus of the development of computer-aided foreign language translation of human-computer interaction will be to apply more mature machine translation technologies to better serve interactive machine translation. With the continuous development of machine translation technology to syntax and semantics, the use of these information in interactive translation technology will become more convenient, which can also promote the in-depth application of user feedback information. Therefore, in the future, the in-depth research on the underlying machine translation technology is also a part of the better development of computer-aided foreign language

translation of human-computer interaction. With more and more available data, it may play an important role in the effective discovery and management of existing knowledge in the construction of translation engine or interactive translation system in the future. The combination of interactive machine translation technology and knowledge discovery and knowledge management technology may bring a new technological leap in the background of big data era.

References

[1] Sariman G., D Çetin. The Effect of Computer Aided Education on the Skill of Word Stressing in Teaching Turkish as a Foreign Language. Universal Journal of Educational Research, 2018, 6(8):1701-1709.

[2] Kook J., Chang J H. A high-level programming language implementation of topology optimization applied to the acoustic-structure interaction problem. Structural and Multidisciplinary Optimization, 2021, 64(6):4387-4408.

[3] Clément W. Royer, O'Neill M., Wright S J. A Newton-CG algorithm with complexity guarantees for smooth unconstrained optimization. Mathematical Programming, 2019, 180(1-2):451-488.

[4] Wang X. Translation correction of English phrases based on optimized GLR algorithm. Journal of Intelligent Systems, 2021, 30(1):868-880.

[5] Nishikawa R M., Bae K T. Importance of Better Human-Computer Interaction in the Era of Deep Learning: Mammography Computer-Aided Diagnosis asaUse Case. Journal of the American College of Radiology, 2018, 15(1 Pt A):49-52.

[6] Salih S Q., Alsewari A R A. A new algorithm for normal and large-scale optimization problems: Nomadic People Optimizer. Neural Computing and Applications, 2019, 32(14):10359-10386.

[7] Ali F., Islam S., Kwak D., et al. Type-2 fuzzy ontology-aided recommendation systems for IoT-based healthcare. Computer Communications, 2018, 119(APR.):138-155.

[8] Chakraborty B K., Sarma D., Bhuyan M K., et al. Review of constraints on vision-based gesture recognition for human–computer interaction. Iet Computer Vision, 2018, 12(1):3-15.

[9] Silva C. HCI International Conference 2018: The 20th International Conference on Human-Computer Interaction. Information Design Journal, 2018, 24(2):197-199.

[10] Perera P L., Liyanage S R. Applications and Challenges in Human-Computer Interaction for EEG-based BCI Systems. International Journal of Scientific and Research Publications (IJSRP), 2021, 1(3):1-8.

[11] D, A, Conway. On Man-Computer Interaction in Organisational Decision-Making. A Behavoural Approach. Journal of the Operational Research Society, 2017, 25(1):200-201.

[12] Ghh A., JJ B, Han J., et al. Human–Computer Interaction Lab (HCIL) in Seoul National University. Visual Informatics, 2020, 4(4):35-39.