Research on the Optimization of English Automatic Translation by Weakening Grammar Rules

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Abstract. At present, with the development of intelligent technology, automatic translation software has been widely used. However, most of the automatic translation forms a rough language processing mechanism, which has a high error rate. To solve this problem, this paper first analyzes the principle of English automatic translation, then studies the optimization of English automatic translation algorithm by weakening grammar rules, and finally verifies the optimization of English automatic translation by weakening grammar rules.

Keywords: English Automatic Translation, Weakening Grammar Rules, Optimization

1. Introduction
At present, automatic translation software has been more and more popular and applied. On the one hand, it is the boost of the development of computer information technology which supports the rapid application of automatic translation software. On the other hand, the timely iteration of artificial intelligence also promotes the rapid update and iteration of automatic translation technology[1-2]. Due to the large number of natural languages in the society, the majority of automatic translation forms a rough language processing mechanism, and the former English automatic translation relies on expert summary, resulting in errors in English translation by weakening rules[3-4]. At present, most of English translation by weakening rules has some problems, such as weak expansibility, inaccurate translation, etc., so how to effectively improve English automatic translation by weakening grammar rules has become a key problem to be solved in the field of English automatic translation[5]. Under the condition of weakening grammar rules, the optimization method of English automatic translation can better adapt to the non-linear spectral features of matching semantics, which is conducive to the realization of feature extraction and recognition of semantic information fusion, so it can better solve the problems in the field of English automatic translation. Therefore, it is of great practical value to research the optimization of English automatic translation by weakening grammar rules.

2. Principles of English automatic translation
There are often obvious grammatical errors in English automatic translation, so it is necessary to
analyze the source sentences of translation and add feature functions reflecting grammatical knowledge to solve translation problems at different grammatical levels[6]. Then, based on the grammar conversion rules, the English phrase corresponding to the phrase in the source statement is connected to complete the translation output. According to the maximum entropy model, the possible feature functions can be given at all levels of grammar, from the simplest binary features to the complex tree structure analysis. The translation model always can be constructed.

2.1. Logic linear model  
The purpose of English automatic translation is to give a source sentence (Chinese):

\[ f = f_1^J = f_1, \ldots, f_j, \ldots, f_J, \]  

(1)

Then automatically translate it into possible target sentences (English):

\[ e = e_1^I = e_1, \ldots, e_j, \ldots, e_I. \]  

(2)

Then, the maximum probability of all possible target sentences:

\[ e_1^I = \arg \max_{e_1^I} \{ P_r(e_1^I | f_1^J) \} \]  

(3)

In the maximum entropy framework, there is a set of characteristic functions:

\[ h_m(e_1^I, f_1^J), \quad m = 1, \ldots, M \]  

(4)

For each characteristic function, there is a model parameter:

\[ \lambda_m, \quad m = 1, \ldots, M \]  

(5)

According to the maximum entropy theory, the direct probability model:

\[ P_r(e_1^I, f_1^J) = p_{\lambda}(e_1^I, f_1^J) \]

\[ = \frac{\exp \left[ \sum_{n=1}^{M} \lambda_n h_n(e_1^I, f_1^J) \right]}{\sum_{e_1^I} \exp \left[ \sum_{n=1}^{M} \lambda_n h_n(e_1^I, f_1^J) \right]} \]  

(6)

The overall structure of the logic linear model is shown in Figure 1 below.
The above formulas are the standard maximum entropy formula, and the principles in these formulas can effectively complete English translation. But most of the translation grammar rules are too dependent on expert summary, which leads to translation errors.

2.2. Characteristic functions of various grammatical phenomena
The feature functions of shallow syntax mainly include word selection:

$$h_{\text{BIRL}}(e_i^j, f_i^j, \pi_i^k, z_i^k) = \log \prod_{j=1}^{f} p(e_i | f_j, (i, j) \in A, E)$$  \hspace{1cm} (7)

The deep processing syntactic feature function is formed by two models, that is, the feature function of tree to string composed of Chinese sentence and English analysis tree, the feature function of alignment probability sum and the feature function of calculating the best alignment:

$$h_{\text{TreeTostringViterbi}}(e, f^j) = \log \left( \max_{\theta(e_{i,j})} \prod_{i=1}^{n} p(\theta(e_{i,j}) | e_{i,j}^k) \right)$$  \hspace{1cm} (8)

It can be seen that the key point of English automatic translation is to effectively mark the components of sentences, accurately identify semantic blocks, and build the process of marking sentence components and identifying semantic blocks.

3. Optimization of English automatic translation algorithm by weakening grammar rules

3.1. Grammatical feature selection
In order to optimize the algorithm of English automatic translation by weakening grammar rules, it is necessary to analyze the English grammar rules, first and foremost, to obtain the rectangular window function under Gaussian marginalization of semantics, get the window feature vector, and project the semantic information entropy data. Secondly, the idea of horizontal feature points is integrated to build a mathematical model of feature recognition. It is driven under the central language, and the translation of the different tenses of the segmented phrases provides the basis for the improvement of English automatic translation.

3.2. Optimization of English automatic translation based on semantic features and weakening grammar rules
In the optimization of English automatic translation by weakening grammar rules, semantic relevance
factors are added to the information entropy and information gains of the text, so as to obtain semantic non-linear spectral features, and finally realize feature recognition. The specific implementation process is as follows: first of all, quantify the multi-dimensional vector in the vector space, the number of words in the document and the frequency of anti-document. Secondly, the feature weights and information gains of semantics are calculated. The probability sum of the same word group and related words in a certain category in the translated text and the weight value of each word in the text are calculated, so as to realize the feature recognition.

In addition, the category of text to be translated is defined as the information source, and the relationship between the word information entropy, and the word weight value is determined by the information gain relationship between the category information entropy of the training data set and the conditional entropy of the words in the document category to be translated. The different categories of words in the text to be translated are segmented by using the classifier of the fusion semantics. The weight value of words in the text to be translated is sorted, and the feature words in front are obtained, which are defined as non-linear spectral features of self-adaptive matching semantics. The feature recognition of semantic information of the text to be translated is completed by using this feature, so as to eliminate the errors that the traditional automatic English translation method is prone to when extracting the semantic features of English.

4. Verification of the results of optimizing English automatic translation by weakening grammar rules

4.1. The accuracy of English automatic translation after algorithm optimization
In order to verify the accuracy of the English automatic translation after the algorithm optimization, randomly select the sentences from the Chinese version magazine of the economist as the test object, and compare the results of the automatic translation with the corresponding sentences in the original English version of the economist magazine. It can be seen that the error rate of the English automatic translation before and after the optimization is shown in Figure 2.

![Figure 2](image)

**Figure 2.** Error rate of the English automatic translation before and after the optimization

Similarly, through the comparison of the feature recognition effect of the automatic English translation of the algorithm before and after optimization, it can be found that the feature recognition and classification effect of the algorithm after optimization is significantly better than that before optimization, which verifies the effect of weakening grammar rules in English automatic translation.
5. Conclusions
At present, most of the English translation by weakening rules has common problems of weak expansion and inaccurate translation. Therefore, the key to carry out the research of English automatic translation is to effectively improve the English automatic translation. Based on the analysis of the principle of English automatic translation, this paper optimizes the algorithm of English automatic translation by weakening grammar rules, and verifies that the optimization of the algorithm of English automatic translation can be realized by weakening grammar rules through simulation, so as to solve the problem of a large number of errors in English automatic translation.

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