EAI Endorsed Transactions
on Scalable Information Systems
Research Article EAI.EU

# Research on Automatic Scoring Method of Intelligent Translation System Based on TSO Optimized LSTM Networks

Wei Li[1,*]

[1]Jiangsu Maritime Institute, Nanjing 211170, Jiangsu, China

## Abstract

INTRODCTION: The study of automatic marking methods in the Department of Language Translation is conducive to the fairness and rationality of marking by examining the comprehensive level of the students' language, as well as sharing the objectivity and pressure of the marking teachers in marking the scripts.
OBJECTIVES: Aiming at the current automatic scoring methods of translation systems, which have the problems of not considering the global nature of influence features and low precision.
METHODS: This paper proposes an automatic scoring method for translation system based on intelligent optimization algorithm to improve the deep network. First, by analyzing the language translation scoring problem, selecting the key scoring influencing factors and analyzing the correlation and principal components; then, improving the long and short-term memory network through the triangle search optimization algorithm and constructing the automatic scoring model of the translation system; finally, the high efficiency of the proposed method is verified through the analysis of simulation experiments.
RESULTS: The proposed method is effective and improves the accuracy of the scoring model.
CONCLUSION: solves the problem of inefficient scoring in the automatic scoring method of the translation system.

**Keywords:** automatic scoring for language translation systems, long and short-term memory networks, triangle search optimization algorithm, automatic scoring feature analysis

Received on 19 October 2023, accepted on 15 February 2024, published on 20 February 2024



doi: 10.4108/eetsis.4858

*Corresponding author. Email: 13952053527@163.com

## 1. Introduction

Economic globalization language learning has gradually become the content of people's attention, thus university language education has become an important part of university education [1]. In order to test the results of students' language learning and the level of applicability, universities and colleges will organize stage exams, final exams, accompanying classroom tests, these assessment data to improve the quality of teachers' language teaching, students' language learning effect has a certain role in promoting, but the large amount of data in the language paper marking work leads to a large amount of manpower and material resources consumption [2]. With the rapid development of Internet technology and artificial intelligence technology, machine-based automated marking and scoring replaces the repetitive labor of manual labor and reduces a large amount of teachers' burden, and its research is increasingly concerned by research scholars and experts [3]. Language assessment questions generally include objective and subjective questions, objective questions are easy to realize automatic scoring, subjective questions include translation and writing, the answer is not unique, so such questions are more difficult to score, and it is even more tricky to realize automatic scoring [4]. The study of automatic scoring method of language translation system is conducive to the comprehensive level of students' language through the examination, and is also conducive to sharing the marking teacher's marking objectivity and pressure, which is more conducive to the fair and reasonable marking of papers [5]. Therefore, the study of high degree of intelligence, high precision, high real-time language translation automatic scoring method of the current university language marking reform and innovation, improve the language teaching management in colleges and universities urgently need to solve the problem [6].

The development of intelligent technology has led to the innovative development of automatic scoring of language translation, and the proposal of automatic scoring method for intelligent translation has attracted the attention of experts in the world field, especially the research of experts and scholars in the education industry [7]. At present, the research of intelligent language translation automatic scoring method is mainly carried out from two aspects of automatic scoring index extraction and automatic scoring model construction of language translation system [8]. Literature [9] proposed to calculate the automatic scoring result of translation system by the number of matching words, which is too simple and does not take into account the semantic relevance; literature [10] proposed to take the matching rate of n-order word elements as the scoring rule, and at the same time, introduced the length penalty ratio to solve the problem of high scores of short sentences; literature [11] synthesized the similarity, test electricity and sentence length and other indicators to construct language translation system scoring model; Literature [12] constructs an automatic scoring model for language translation system by utilizing the shape similarity and test point methods, combined with the support vector machine algorithm; Literature [13] combines text similarity with natural language processing technology, and proposes an automatic scoring method for language translation system based on machine learning algorithms by utilizing the support vector machine method; Literature [14] collects the scores of language translation system through anticipation, manual scoring, text feature extraction preprocessing to obtain training and testing data, and proposed a translation automatic scoring method based on particle swarm optimization algorithm to improve neural networks; literature [15] proposed a scoring method based on multivariate current regression and random forest by analyzing the automatic scoring process of English-Chinese translation questions and combining it with machine learning algorithms; literature [16] analyzed the scoring of the translation system starting from the semantic features, and proposed a multi-intelligent method fusion of the translation system scoring features, and proposed an automatic scoring method for translation system with the fusion of multi-intelligence methods; Literature [17] analyzed the language translation scoring features from the perspectives of literal overlap, keywords, semantics, etc., and constructed an automatic scoring model by using an improved recurrent neural network. In view of the above literature analysis, the existing automatic scoring methods for language translation system have the following defects: 1) they are not considered comprehensively and lack the comprehensiveness of feature elements and the completeness of the process; 2) the accuracy of the automatic scoring model is not sufficiently high, and the application is not generalized enough [18].

Swarm Intelligence Optimization Algorithm (SIA) is a common algorithm in computational intelligence, and its basic theory is to simulate the behaviors of animal groups such as schools of fish, flocks of birds, swarms of bees, wolf packs, and bacterial swarms in nature, and to use the information exchange and cooperation among groups to achieve the optimization through the simple and limited interactions among individuals [19]. Long and short-term memory network is a kind of recurrent neural network, which can solve the shortage of short-term memory of recurrent neural network, when a sequence is long enough, then the recurrent neural network will be very difficult to transfer information from earlier time step to later time step, and long and short-term memory network can learn the information that depends on the long term, and memorize the information of the earlier time step, and therefore can be able to do the connection of the context [20]. The combination of long and short-term memory networks, intelligent optimization algorithms makes the automatic scoring method to improve the accuracy and real-time ways of new ideas, making the study of automatic scoring methods based on intelligent optimization algorithms to improve the recurrent neural network become a hot spot of expert research.

Aiming at the problems existing in the current automatic scoring method of translation system, this paper proposes an automatic scoring method of translation system based on intelligent optimization algorithm to improve deep learning network. The main contributions of this paper are: analyzing the problem of automatic scoring of language translation system, extracting scoring features, combining long and short-term memory network and intelligent optimization algorithm, proposing an automatic scoring method of translation system based on triangle search optimization algorithm to improve the long and short-term memory network, and verifying through experiments that the method of this paper has a higher analytical accuracy and meets the requirements of real-time performance.

## 2. Analysis of Language Translation Scoring Issues

Automatic scoring by language translation refers to the transformation of the current student response images into response text, obtaining the text data of each question block through test cutting, training the scoring model by using the reference answers and scoring guidelines of each question block, and finally automatically scoring the trained model by student language translation [21].

The auto-grading process mainly includes the steps of test paper scanning, test question cutting, graphic conversion, test rule entry, auto-grading and result output, and the flow chart is shown in Figure 1.

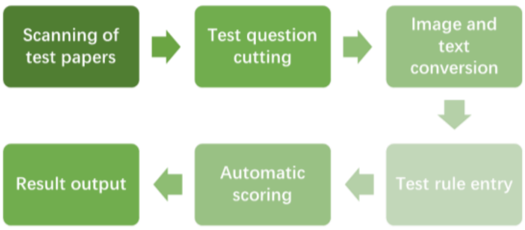



**Figure 1** Automated scoring process

## 3 Characterization of the impact of automated scoring

Analyze the correlation and main features of each influencing factor by extracting the auto-scoring prediction influencing features.

### 3.1 Impact feature extraction

The automatic scoring prediction influence feature carries out influence feature extraction and analysis according to three aspects such as basic features, formal features and semantic features, as shown in Fig. 2, which is expressed as follows:

(1) Basic characteristics

The basic features of the language translation system include the ratio of the length of the answer text to the reference answer text $X_1$ , the ratio of the number of spelling errors $X_2$ , and the 1~4 tuple matching rate $X_3$ , where the tuple matching rate [22] is calculated as follows:

$$BLEU = BP \cdot \exp\left(\sum_{n=1}^{N} w_n \log p_n\right) \tag{1}$$

Among them, $N$ is the maximum length of matching tuple, which generally takes the value of 4; $w_n$ is the combination weight of tuple matching rate; $BP$ indicates the length penalty ratio; $p_n$ is the matching rate of tuple.

(2) Formal characteristics

The formal features of the language translation system include the average length of verb phrases $X_4$ , the average length of noun phrases $X_5$ , and the matching rate of word quintuplets $X_6$ , of which $X_4$ and $X_5$ involve the analysis of sentence structure. In this paper, the StanfordCoreNLP algorithm is used to analyze the syntax, and the verb phrase and noun phrase lengths are obtained through syntactic analysis tree analysis [23].

(3) Semantic features

The semantic features of the language translation system include the keyword translation rate $X_7$ , the potential semantic similarity $X_8$ , and the text distance $X_9$ . The potential translation rate indicates the correctness of keyword translation and is calculated as follows:

$$keyTrans = \frac{\sum_{n=1}^{N} accuracy_n}{N} \tag{2}$$

where $accuracy_n$ denotes the accuracy.

Potential semantic similarity [24] is based on the traditional vector space model, the relationship between words and vectors is projected onto the potential semantic space, and the specific steps of potential semantic analysis are as follows: 1) Construct the word-text matrix; 2) Adjust the weights of the words; 3) Decompose the matrix; and 4) Calculate the text similarity.

Text distance is calculated as the Euclidean distance between word vectors on the basis of word vectors.

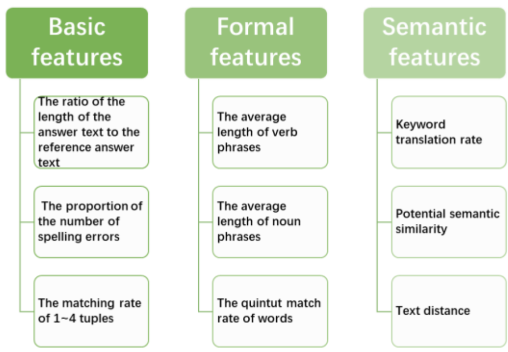



**Figure 2** feature extraction

### 3.2 Correlation analysis

In order to analyze the redundancy of automated scoring affecting the amount of feature inputs, this paper investigates scoring feature correlation analysis. Pearson was used to calculate the correlation coefficient [25], which takes the value range of $[-1,1]$ . The calculation formula is as follows:

$$\rho(x,y) = \frac{\operatorname{cov}(x,y)}{\sigma(x) \cdot \sigma(y)} = \frac{E\left[(x-\mu_x)(y-\mu_y)\right]}{\sigma(x) \cdot \sigma(y)} \tag{3}$$

Where $\operatorname{cov}(x,y)$ is the coefficient of variation, $\sigma(x)$ and $\sigma(y)$ are the standard deviations.

## 3.3 Principal component analysis

In order to reduce the redundancy of automatic scoring affecting the amount of feature input, this paper chooses the kernel principal component analysis method [26] for dimensionality reduction. The steps of automatic scoring feature extraction for language translation system based on kernel principal component analysis method are as follows:

Step 1: Standardized processing of indicator features. In order to eliminate the difference in scale between different impact factors, the original data matrix is standardized, and the standardized matrix $Z$ is obtained by using the Z-Score method, where $n$ is the number of samples, and $d$ is the dimension of the sample indicator characteristics.

Step 2: Calculate the formula for the correlation coefficient between each indicator:

$$\sigma_{ij} = \frac{\sum_{k=1}^{n}\left(z_{ki}-\bar{Z}_i\right)\left(z_{kj}-\bar{Z}_j\right)}{\sqrt{\sum_{k=1}^{n}\left(z_{ki}-\bar{Z}_i\right)^2\left(z_{kj}-\bar{Z}_j\right)^2}} \tag{4}$$

Where $z_{ki}$ denotes the standardized value of the ith indicator for the kth sample; $\bar{Z}_i$ is the mean value of the ith indicator; $\sigma_{ij}$ is the covariance of the vectors $Z_i$ and $Z_j$ .

Step 3: Select the Gaussian kernel function as the kernel function and calculate the kernel function value:

$$K\left(z_i, z_j\right) = \exp\left(-\gamma\left\|z_i - z_j\right\|^2\right) \tag{5}$$

where $\gamma$ is a Gaussian kernel function parameter that controls the distribution of data points in the high dimensional space.

Step 4: Compute the diagonal matrix $\Lambda$ of the symmetric positive definite matrix $K$ to obtain the characteristic roots $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_d$ .

Step 5: Determine the contribution of the matrix $K$ . Calculate the contribution of the ith principal component $\omega_i$ :

$$\omega_i = 1 \Big/ \sum_{j=1}^{d} \lambda_j \tag{6}$$

Step 6: Determine the number of principal components *k*. Sort the components one at a time according to the magnitude of the contribution rate, determine the information retention threshold after decoupling $\alpha$ , and if the cumulative contribution rate of the first k components $\rho$ is greater than $\alpha$ , then the number of principal components is k.

$$\rho = \sum_{i=1}^{k} \omega_i \tag{7}$$

Step 7: Output the *k* indicator features associated with the principal components.

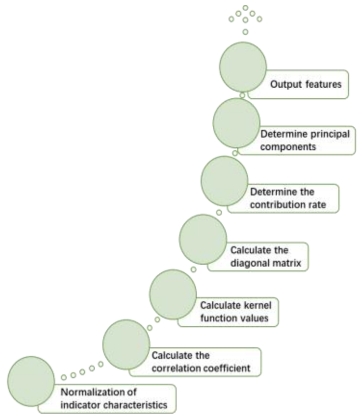



**Figure 3.** Flow of automatic scoring influence feature selection based on kernel principal component analysis

# 4. Triangle Search Optimization Algorithm

In order to overcome the neural network-based automatic scoring method that may fall into the local optimum problem, this section proposes an evolutionary optimization algorithm based on triangular inspiration, Triangle search optimization (TSO) algorithm [27]. This algorithm was proposed by Zhenglei Wei in 2020, which mainly solves the PV model parameter identification problem and the tactical maneuver decision problem, and achieves better results in the IEEE CEC 2020 test set.

The TSO algorithm is inspired mainly by the phenomenon of triangle characterization. Triangles are categorized as acute, obtuse, and right triangles. It is assumed that the triangle vertex is the optimization solution, through the dimension of the solution, which makes the triangle expand to multi-dimensional; the sides of the triangle are considered to be the search direction that can be computed; and the angle of the triangle can be calculated through the equation of the side and the angle calculation. Based on the above analysis of triangle search theory, TSO is divided into angle search (Triangle vertex search, TVS) phase and edge search (Triangle edges search, TES) phase.The specific description of TSO algorithm is as follows:

(1) Initialize the triangular vertex population. each vertex individual of the TSO is randomly initialized using a uniform distribution.

(2) Triangle vertex search phase.TSO utilizes categorical probability variables to divide the vertex population into an evolutionary operator population and a Gaussian distribution estimation operator population. The first subpopulation uses Gaussian distribution estimation operator to update individuals; the second subpopulation updates individuals with different evolutionary strategies according to the type of angle between the current point and the other two points. The type of angle between the three points is mainly categorized into three states: acute angle, obtuse angle (including right angle), and invalid angle, and the formula for the angle of the *ith* vertex individual $x_i$ is as follows:

$$angle_i = \frac{\left(x_{pbest} - x_i\right)\cdot\left(x_{r1} - x_i\right)}{\left\|x_{pbest} - x_i\right\|_2 \cdot \left\|x_{r1} - x_i\right\|_2} \quad (8)$$

Where $x_{pbest}$ denotes the optimal individual in the target vector and $x_{r1}$ denotes the $r1\left(r1 \neq i\right)$ th vertex individual. According to the pinch type, the specific evolutionary strategy is defined as follows:

State 1: If the current pinch angle is acute, two differential evolution operators are used for the corresponding vertices, and the specific strategy is computed as follows:

$$v_i^G = x_i^G + F_{1,i}^G\left(x_{pbest}^G - x_i^G\right) + F_{2,i}^G\left(x_{r1}^G - x_i^G\right),\ angle_i > 0 \quad (9)$$

Where $x_i^G$ and $x_{r1}^G$ denote the *ith* and $r1\left(r1 \neq i\right)$ target vectors of generation *G*; $x_{pbest}^G$ denotes the optimal individual in the target vector of generation *G*; $F_{1,i}^G$ and $F_{2,i}^G$ denote the two scaling factors of the *ith* target vector of generation *G*. The first differential evolution operator is mainly to keep close to the optimal individual, and the second differential evolution operator is mainly to increase the population diversity. In Eq. The first differential evolution operator is mainly to keep close to the optimal individual, and the second differential evolution operator is mainly to increase the diversity of the population.

State 2: If the current pinch angle is obtuse or right angle, two differential evolution operators are also used:

$$v_i^G = x_i^G + F_{1,i}^G\left(x_{pbest}^G - x_i^G\right) + F_{2,i}^G\left(x_i^G - x_{r1}^G\right),\ angle_i \le 0 \quad (10)$$

Where, unlike state 1, the second differential evolution operator of Eq. changes, mainly to speed up the population optimization convergence.

State 3: If the current vertices cannot form a triangle, the current angle is considered as an invalid angle. This state uses the current-to-pbest/1 mutation strategy [28].

(3) Triangle edge search stage. The TES stage divides the population into $100p\%$ better solution, $NP - 2*\left(100p\%\right)$ intermediate solution, and $100p\%$ worse solution. In order to improve the population search diversity, TES utilizes the sum of the difference vector between the better and worse solutions and the intermediate solution to update the population individuals, which is calculated as follows:

$$v_i^G = x_r^G + F_i^G(x_{pbest}^G - x_{pworst}^G) \quad (11)$$

where $x_r^G$ denotes a randomly selected individual from the intermediate solution, $x_{pworst}^G$ denotes the *Gth* generation worse solution individual, and $F_i^G$ is the scaling factor.

(4) Perform crossover operator. According to the crossover rate $Cr$ , the test vector $u_i^G$ is obtained from the crossover of the target vector with the variant vector.

(5) The better vectors are selected to create new populations. Based on the comparison of fitness function values between $x_i^G$ and $u_i^G$ , the vector having the better fitness value is selected.

(6) If the current number of evaluations $nfes$ reaches the maximum number of evaluations $\max\_nfes$ , the optimization process is stopped and the optimal value is output.

## 5. Long- and short-term memory networks

Traditional feed-forward neural networks are unable to use the information learned at the previous moment to model the data at the current moment, and thus are less effective in handling time-series problems. Recurrent Neural Network (RNN), due to the combination of both feed-forward and recurrent connections, makes each unit in its hidden layer correlate with its state at different time steps, and thus can better handle time-series problems. Thus, it can better handle the timing problem. Figure 4 shows the basic structure of Artificial Neural Network (ANN) compared to RNN.

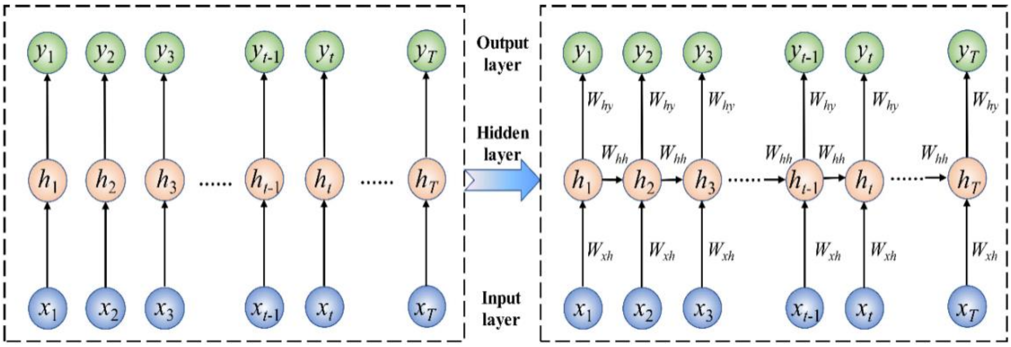



**Figure 4.** Comparison of ANN and RNN network structure

Although RNN has some advantages in dealing with time series problems, it is prone to the problem of gradient vanishing during backpropagation. As the training time increases, the weights begin to oscillate and the network quality will degrade. To solve this problem, Hochreiter and Schmidhuber proposed Long Short-Term Memory networks (LSTM) [29]. As an improved version of RNN, LSTM networks are based on the idea of gating and new memory modules are designed to replace the original hidden units in RNN. Long time dependencies are modeled by maintaining the gradient paradigm during backpropagation. Figure 5 illustrates its basic network internal structure. In LSTM, a memory cell and three different types of gates (input gate, output gate, and forget gate) are encapsulated within each memory module. A memory module can be viewed as a memory chip in a digital computer, and its operation is similar to the write, read, and reset signals in that chip. Specifically, input gates and output gates control the input activation stream into the memory cell and the cell activation output stream into the rest of the network, respectively. In particular, the input gate determines the amount of input information to be stored in the hidden state. The output gate focuses on what hidden state information should be included in the current time step output. The forgetting gate then directly determines the hidden state information that should not be further memorized. Input and output gates help to solve the problem of vanishing error in traditional RNNs: the local error remains unchanged in the absence of new inputs or error signals. In addition, the forgetting gate can adaptively forget or reset the cell's memory, thus avoiding infinite loops in the network. Overall, the memory cell preserves the knowledge of the previous step, it is self-connecting and can store the temporal state of the network, and the gates control the updating of information and the way forward. These properties also make LSTMs easier to train than conventional RNNs.

For the input time series prediction, the LSTM updates the storage unit and outputs the hidden state based on the following computations, which are performed at each time step. The following equations describe the complete mechanism of this process:

$$i_t = \sigma\left(W_{xi}X_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i\right) \quad (12)$$

$$f_t = \sigma\left(W_{xf}X_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f\right) \quad (13)$$

$$c_t = f_t c_{t-1} + i_t \tanh\left(W_{xc}X_t + W_{hc}h_{t-1} + b_c\right) \quad (14)$$

$$o_t = \sigma\left(W_{xo}X_t + W_{ho}h_{t-1} + W_{co}c_t + b_o\right) \quad (15)$$

$$h_t = o_t \tanh\left(c_t\right) \quad (16)$$

$$y_t = \sigma\left(W_{yh}h_t\right) \quad (17)$$

where $i_t$ , $f_t$ , $o_t$ , and $c_t$ are the vectors of input gates, forgetting gates, output gates, and memory cells, respectively ; $b_i$ , $b_f$ , $b_o$ , and $b_c$ are their corresponding bias vectors; and $W$ is the weight matrix of the connection between the two components. For example, $W_{x\square}$ , $W_{h\square}$ , $W_{c\square}$ , and $W_{y\square}$ are the weights of the input vector, the hidden vector, the memory cell, and the output vector in relation to the other components, $h_t$ is the hidden state vector, and $y_t$ is the final output vector.

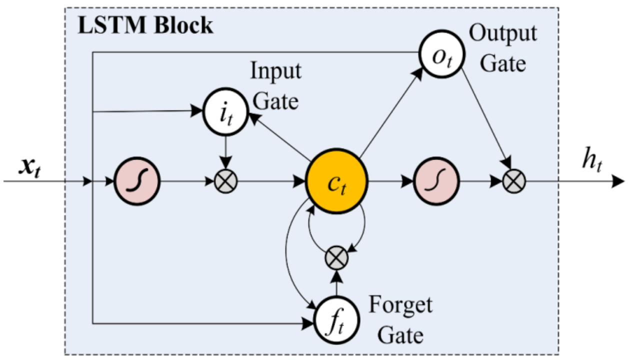



**Figure 5.** Internal structure of LSTM

## 6. Ideas of Automatic Scoring Method for Intelligent Language Translation System Based on TSO Algorithm Improved LSTM Networks

### 6.1. Decision Variables and Objective Functions

Due to the increased temporal order, the network training of LSTM adopts Back-Propagation Through Time (BPTT) algorithm. When the network structure tends to be complex and the size of the training data increases, the convergence rate of the BPTT algorithm will drop linearly, and it is very easy to fall into the local optimum, resulting in network training failure. To address the above problems, this paper adopts the Triangle Search Optimization (TSO) algorithm to improve the optimization process of LSTM network parameters. $\left[W_{yh}, W_{xi}, W_{hi}, b_i, W_{xf}, W_{hf}, b_{f,} W_{xc}, W_{hc}, b_{c,} W_{xo}, W_{ho}, b_{o,}\right]$ is the optimization decision variable of the TSO algorithm.

In order to improve the efficiency of TSO algorithm to optimize LSTM convergence optimization, the root mean square error function is used as the objective function of TSO-LSTM algorithm, which is calculated as follows:

$$\min f(\omega, a, b) = \sqrt{\frac{1}{K}\sum_{k=1}^{K}\left(y(k) - y_{predict}(k)\right)^2} \tag{18}$$

Where $y(k)$ is the actual value and $y_{predict}(k)$ is the predicted value.

### 6.2 Methodological process

Combining the TSO algorithm and LSTM network, this section proposes an automatic scoring method for intelligent translation systems based on the TSO algorithm to improve the LSTM network. The analysis model mainly takes the automatic scoring feature volume as input and the scoring value as output, and constructs the mapping relationship between the influence features and the scoring value. The flowchart of the automatic scoring method of intelligent translation system based on TSO algorithm to improve LSTM network is shown in Figure 6. The specific steps are as follows:

Step 1: Take the English translation system scoring as a case study, obtain the data of translation questions and extract the influence features of the automatic scoring of the translation system; pre-process the acquired samples and adopt the sparse smoothing data processing method;

Step 2: Correlation analysis is performed on the preprocessed data, and if redundancy exists, the influence features are extracted using kernel principal component analysis for dimensionality reduction;

Step 3: Normalize the raw data with Z-Score method and divide the data into test set, validation set & training set;

Step 4: The initial parameters of the LSTM network are encoded using the TSO algorithm, and the algorithm parameters such as the population parameters and the number of iterations are also initialized; the population is initialized and the objective function value is calculated;

Step 5: Update the seed position using the triangle vertex search phase and the triangle edge search phase;

Step 6: In each iteration, it is necessary to compare the objective function value of each planet with the objective function value of the current global optimal solution and update the global optimal solution;

Step 7: Judge whether the termination condition is satisfied. If it is satisfied, exit the iteration, output the optimal LSTM parameters and execute step 8, otherwise continue to execute step 5;

Step 8: Decode the TSO-based optimized LSTM parameters to obtain the optimal network parameters;

Step 9: Construct the TSO-LSTM auto-scoring model, train the model using the training set, input the test set into the model, and get the evaluation results and error analysis results.

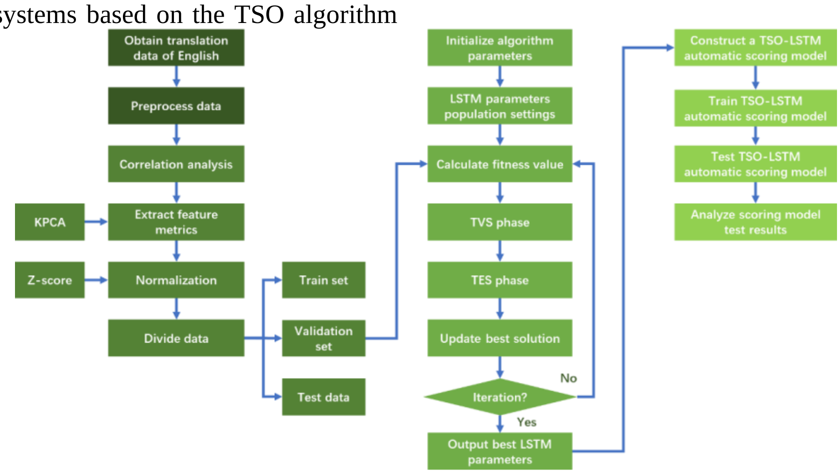



**Figure 6.** Flowchart of automatic scoring method for intelligent language translation system based on TSO-LSTM networ

## 7. Simulation analysis

In order to verify the effectiveness, accuracy and real-time performance of the automatic scoring model of the intelligent language translation system proposed in this paper, five algorithms are selected for comparison, and the specific parameter settings of each algorithm are shown in Table 1.The training data, validation data and test data are mainly from the data of the English translation question type, and the training samples are 500 and the test samples are 50.The experimental simulation environment is Windows 10, and the CPU is 2.80GHz, 8GB memory, programming language Matlab2019b.

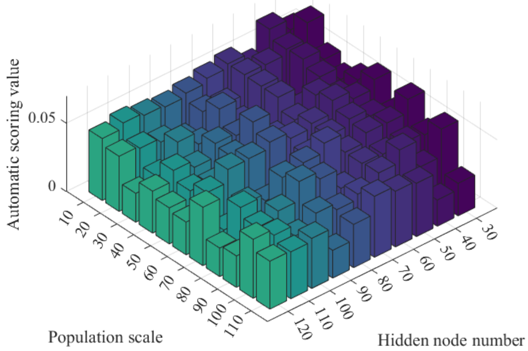
Table 1 Parameter settings for automated scoring methods

| arithmetic | parameterization |
|---|---|
| BP | The layer node is 50, and the activation function is radial basis function |
| CNN | Convolutional layer 30 convolutional kernels, Relu activation, Maximized pooling layer, Fully connected layer 10 nodes |
| RF | N_tree=300, m_try=floor(80.5) |
| DELM | Two hidden layers with the number of nodes in each layer 20, 20 |
| LSTM | The number of hidden layer nodes is 50 and Adam optimization adjusts the weights |
| TSO-LSTM | The number of nodes in the hidden layer is determined by section 6.1, and the number of populations is determined by section 6.1 |

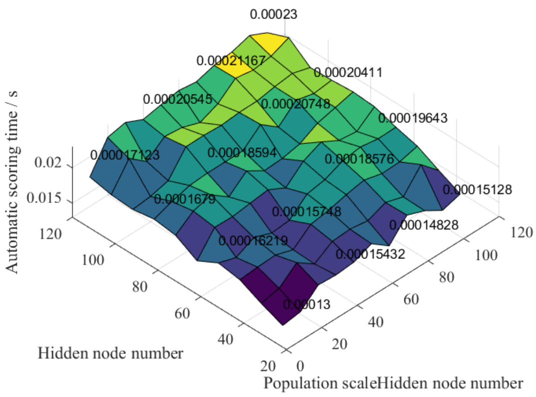
### 7.1 Analysis of model parameter settings

In order to analyze the impact of the TSO-LSTM algorithm on the performance of the model using the test effect analysis, this paper analyzes the parameters of the TSO-LSTM algorithm, and the specific analysis of the statistical results are shown in Figure 7.

Figure 7 gives the effect of different population sizes and number of nodes on the performance of the automatic scoring method based on TSO-LSTM algorithm. From Figure 7(a), it can be seen that the automatic scoring accuracy of the translation system increases as the number of populations of the TSO algorithm increases, and as the number of nodes in the hidden layer of the LSTM network increases, the automatic scoring accuracy of the translation system increases. It can be seen from Figure 7(b) that as the number of populations increases, the automatic scoring time increases; as the number of nodes in the TSO-LSTM algorithm network increases, the automatic scoring time increases. In summary, the increase in the number of populations and the increase in the number of network nodes of the TSO-LSTM algorithm are conducive to the increase in the accuracy of automatic scoring, but the automatic scoring time increases. In order to balance the contradiction between time and accuracy, the population number of TSO-LSTM algorithm should be selected as 50 and the number of network nodes should be selected as 150.




(a) Scoring accuracy analysis




(b) Scoring time analysis

**Figure. 7** Effect of different population sizes and number of network nodes on the performance of the TSO-LSTM algorithm for automatic scoring

## 7.2 Model validity analysis

In order to verify the effectiveness and superiority of the automatic scoring method based on the TSO-LSTM algorithm, TSO-LSTM is compared with five other models such as BP, CNN, RF, DELM, and LSTM, and the scoring results of each model are shown in Figure 8.

Figure 8 gives the relative error between the automatic scoring value and the true value of the translation system based on each algorithm. As can be seen from Figure 8, the absolute value of the relative error of the automatic scoring value of the translation system based on the TSO-LSTM algorithm is controlled within 0.009, and the absolute value of the relative error of the BP algorithm, the CNN algorithm, the RF algorithm, the DELM algorithm, and the LSTM algorithm is controlled within 0.11, 0.068, 0.122, 0.057, and 0.038, respectively. It can be seen that the accuracy of the automatic scoring method of translation system based on TSO-LSTM algorithm is better than the other five models. In summary, the error of the automatic scoring method for translation systems based on the TSO-LSTM algorithm is the smallest overall.

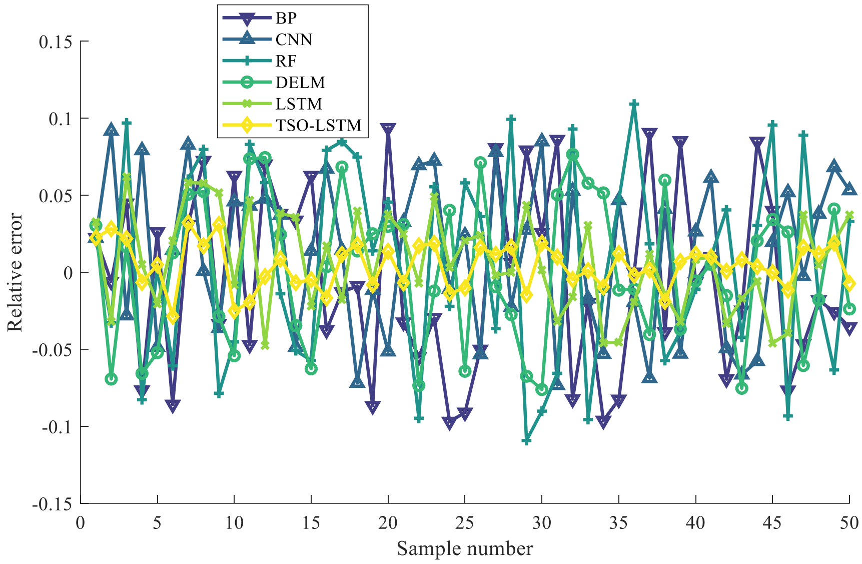



**Figure 8.** Relative error between automatic scoring values and true values based on each algorithm

## 7.3 Comparative analysis of model real-time

In order to further verify the superiority of the automatic scoring method for translation systems based on the TSO-LSTM algorithm, the time performance of TSO-LSTM is compared with that of the other five methods, and the scoring time results of each algorithm are shown in Figure 9.

Figure 9 gives a comparison of the automatic scoring time results of translation systems based on each algorithm. As can be seen from Figure 9, in terms of scoring time variance, the automatic scoring method of translation system based on TSO-LSTM algorithm has the smallest scoring time variance and is ranked as No. 1; in terms of scoring time standard deviation, the scoring time mean of the automatic scoring method of translation system based on TSO-LSTM algorithm is smaller than that of BP, CNN, and RF, and is larger than that of DELM, and LSTM.In summary, the automatic scoring method time based on the TSO-LSTM algorithm of translation system automatic scoring method time satisfies real-time.

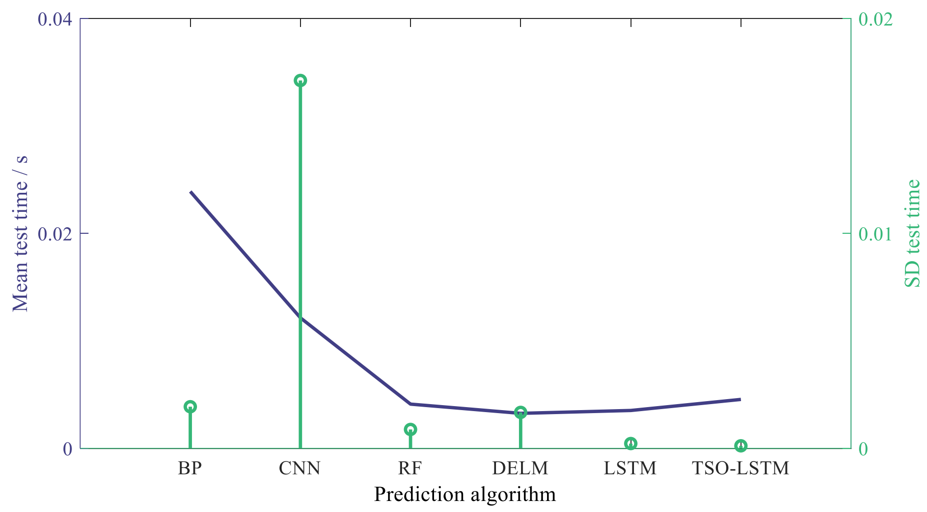



**Figure 9.** Comparison of automatic scoring time metrics for translation systems based on each algorithm

## 8. Conclusion

Aiming at the problem of poor accuracy of the current automatic scoring model, this paper proposes an automatic scoring method for translation system based on TSO optimization to improve LSTM network. The method analyzes the language translation scoring problem, extracts the influencing factors of automatic scoring, and adopts the kernel principal component analysis method to extract the features of the influencing factors; uses the TSO algorithm to optimize the LSTM model, and constructs the automatic scoring method of translation system. Through simulation, the following conclusions are drawn:

(1) The automatic scoring model feature components were analyzed using a KPCA-based analysis method, and it was verified that the KPCA analysis could improve the efficiency of the automatic scoring model by comparing the automatic scoring model that did not use the principal component analysis method;

(2) The LSTM automatic scoring model based on TSO optimization is not only better than other models in scoring accuracy, but also the scoring time satisfies the real-time.

Although the algorithm proposed in this paper can improve the accuracy and real-time performance of the automatic scoring model, the optimization efficiency needs to be further improved. In the subsequent research, the random forest will be improved by combining deep learning to improve the execution efficiency of the algorithm.

## References


[1] **Journal article:** Sebastian M P , Kumar G S .Malayalam Natural Language Processing: Challenges in Building a Phrase-Based Statistical Machine Translation System[J].ACM transactions on Asian and low-resource language information processing, 2023.

[2] **Journal article:** Fengqi L .A comparative study on the quality of English-Chinese translation between translation learners and a machine translation system in the era of artificial intelligence[J].Foreign Language World, 2022(4):72-79.

[3] **Journal article:** Mosedale A , Hendrie D , Geelhoed E ,et al. Realist evaluation of the impact of the research translation process on health system sustainability: a study protocol[J].BMJ open, 2022, 12(6):e045172.

[4] **Journal article:** Flores C A , Figueroa R L , Pezoa J .Active Learning for Biomedical Text Classification Based on Automatically Generated Regular Expressions[J].IEEE Access, 2021, 9:38767-38777.

[5] **Journal article:** Qiu J , Shi C , Lv Y .Three Approaches for Detecting Direct Output Cheating in Program Online Judge Systems[J].International Journal of Software Engineering and Knowledge Engineering, 2023, 33(04):461-486.

[6] Journal article: Staton D , Bellah J .Development of Player-Friendly Web-Based Golf League Management Application[J]. Software Engineering and Applications (English), 2022(003):015.

[7] **Journal article:** Zhai X , He P , Krajcik J .Applying machine learning to automatically assess scientific models[J]. teaching, 2022.

[8] **Journal article:** Korn D .Monitoring Software Assigns Production Scores[J].Production Machining, 2021(7):21.

[9] **Journal article:** eom S K , Seegerer P , Lapuschkin S , Ninder A, Samek W. Pruning by Explaining: a Novel Criterion for Deep Neural Network Pruning[J]. Pattern Recognition, 2021(12):107899.

[10] **Journal article:** Akshat K , Heath G , Ashley K , Carly S, Kirk R. Closing the loop: automatically identifying abnormal imaging results in scanned documents[J].Journal of the American Medical Informatics Association, 2022(5):5.

[11] **Journal article:** Chhabra A .Quality of Hand Radiograph Collimation Determined by Artificial Intelligence Algorithm Correlates with Radiograph Quality Scores Assigned by Radiologists[J].Radiation, 2021, 1.

[12] **Journal article:** David Sánchez, Viejo A , Batet M .Automatic Assessment of Privacy Policies under the

GDPR[J].Applied Sciences, 2021, 11(4):1762.
[13] **Journal article:** Dillon P , Aimmanee P , Wakai A , Sato G, Hung H V, Karnjana J. A Novel Recursive Non-Parametric DBSCAN Algorithm for 3D Data Analysis with an Application in Rockfall Detection[J].Journal of disaster research, 2021, 16:579-587.
[14] **Journal article:** Xu, C.W.. Dragon architecture:A practice of open and autonomous instruction set architecture[J]. Computer Research and Development, 2023, 60(1):1-1.
[15] **Journal article:** Liu, B.. Application of automatic scoring system for Chinese-English translation based on answer knowledge base[J]. Automation Technology and Application, 2021, 40(12):152-155.
[16] **Journal article:** Zhong Qidong,Zhang Jingxiang. A Chinese composition scoring algorithm with embedded language depth perception[J]. Computer Engineering and Applications, 2020, 56(8):6.
[17] **Journal article:** Qiu J , Shi C , Lv Y .Three Approaches for Detecting Direct Output Cheating in Program Online Judge Systems[J].International journal of software engineering and knowledge engineering, 2023.
[18] **Journal article:** Li M , Miao Z , Lu Y .LabanFormer: multi-scale graph attention network and transformer with gated recurrent positional encoding for labanotation generation[J].Neurocomputing, 2023.
[19] **Journal article:** Fei W, Liu C, Hu S. Research on swarm intelligence optimization algorithm[J]. Telecommunications, 2020, v.27(03):5-24+34.
[20] **Journal article:** Lai, W.T.,Chen, Y.. A variable-duration S-T classroom teaching analysis method based on DPRNN speech separation[J]. Journal of Hubei Second Normal College, 2023, 40(2):86-92.
[21] **Journal article:** Han L , Piao J , Tong Y , Yu B, Lan P. Deep learning for non-rigid 3D shape classification based on informative images[J]. Multimedia tools and applications, 2021(1):80.
[22] **Journal article:** Li Haili,Wang Jinhai. An automatic evaluation method of Chinese-English translation text accuracy based on intelligent data processing[J]. Automation Technology and Application, 2022, 41(8):4.
[23] **Journal article:** Ma Zhuo. An investigation of university English translation teaching mode based on automatic evaluation system[J]. Frontiers of Educational Research: Chinese and English Edition, 2023, 13(2):6-10.
[24] **Journal article:** Wu W , Li L .Automated Chinese-English translation scoring based on answer knowledge base[C]//Cognitive Informatics & Cognitive Computing (ICCICC), 2013 12th IEEE International Conference on.
[25] **Journal article:** Du Chuanjia,Wang Chengjun. Research on the structural characteristics of inter-provincial digital economy spatial correlation network and its influencing factors in China[J]. Statistics and Decision Making, 2023(4):106-110.
[26] **Journal article:** Lv X , Chen W , Bai X .Energy consumption modelling analysis of prefabricated buildings based on KPCA-WL SSVM[J]. 2022.
[27] **Journal article:** Wei Z , Huang C , Wang X , Zhang H. Parameters identification of photovoltaic models using a novel algorithm inspired from nuclear reaction[C]//2019 IEEE Congress on Evolutionary Computation (CEC).IEEE, 2019.
[28] **Journal article:** Li Y , Han T , Zhou H , Tang S, Zhao H. A novel adaptive L-SHADE algorithm and its application in UAV swarm resource configuration problem[J].Information Sciences: an International Journal, 2022:606.
[29] **Journal article:** Zhang Y , Cui Z , Liu C , Sun J, Wang K. Stacked bidirectional LSTM RNN to evaluate the remaining useful life of supercapacitor[J]. International Journal of Energy Research, 2022, 46(3):3034-3043.