Encryption and Compression Storage Method of Educational Resources Based on Complex Network and Big Data Analysis

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Abstract. In order to improve the information retrieval and mining capability of educational resources, encryption, compression and storage processing are required. An encryption, compression and storage model of educational resources based on complex network and big data analysis is proposed. A dynamic characteristic information collection and information fuzzy clustering model of educational resource information is constructed, educational resource information sampling is carried out by adopting a wireless sensing matrix of a complex network, metadata structure characteristics of the educational resource information are extracted, a multi-dimensional characteristic space structure distributed fusion method is adopted, educational resource encryption compression and adaptive allocation of information coding are carried out, random coding keys and decoding keys of the educational resource information are extracted, random linear coding technology is adopted to realize encryption, compression and storage of the educational resource information, and dynamic compression capability of the educational resource data is improved. The simulation results show that this method has better feature compression capability and higher precision of encrypted transmission of educational resources information, and improves the precision and recall of educational resources information.

Keywords: Complex network · Big data analysis · Educational resources · Encryption · Compression · Storage

1 Introduction

Complex network and big data analysis provide new opportunities for the optimal allocation and integration of educational resources, and co creation and sharing gradually become a new mode of resource construction. The construction mode of CO creation and sharing is coupled with the characteristics of continuous evolution and natural value-added of digital education resources in the circulation process, which conforms to the
open concept of knowledge value co-creation and can promote the sustainable development of education resources ecology [1]. With the progress of science and technology, more and more people are developing and using educational resources. China is a vast country with different types of educational resources to be developed and utilized. With the development of complex network and big data processing technology of educational resources, it has an important application prospect to collect physical information by using complex educational resources information distribution network in information detection and data monitoring. In the process of data collection of complex educational resource information distribution network, due to the influence of environmental factors, the accuracy of educational resource information detection is not high, and the anti-interference performance is poor. Optimize the data detection design of the complex educational resource information distribution network, combine with the educational resource information compression processing technology, reconstruct the complex educational resource information distribution network information, and improve the mining ability of educational resource information. The research on information mining and reconstruction technology of educational resources has attracted great attention [2].

The method of big data analysis is adopted to carry out automatic monitoring of educational resource information. According to the results of feature extraction and fuzzy identification, the dynamic compression and reconstruction of educational resource information are carried out. The research on educational resource encryption and compression and information coding methods is of great significance in the optimization mining and automatic detection of network data [3]. In traditional methods, the subspace identification method is mainly adopted to establish the educational resource encryption and compression storage model. Combined with the method of large data distributed structure reorganization of complex educational resource information distribution network, the resource information encryption transmission and information reorganization are carried out, and the corresponding adaptive algorithm is combined to realize the feature extraction and reconstruction of educational resource information. However, the traditional method of educational resource encryption compression storage has poor adaptability and large time cost [4]. In order to solve the above problems, this paper proposes an encryption and compression storage model for educational resources based on complex networks and big data analysis. Firstly, the dynamic feature information collection and fuzzy clustering model of educational resource information are constructed. The wireless sensor array of complex network is used to sample educational resource information. The collected educational resource information is combined with features and extracted automatically. Then the metadata structure features of educational resource information are extracted. The multi-dimensional feature space structure distributed fusion method is adopted to carry out educational resource encryption compression and adaptive allocation of information encoding. The random encoding key and decoding key of educational resource information are extracted. The random linear encoding technology is adopted to realize encryption, compression and storage of educational resource data, thus improving the dynamic compression capability of educational resource data. Finally, the simulation test analysis is carried out and the validity conclusion is drawn.
2 Educational Resources Information Sampling and Feature Combination and Information Automatic Extraction

2.1 Educational Resources Information Sampling

In order to realize the encryption, compression and storage of educational resources, the dynamic characteristic information collection and fuzzy clustering model of educational resources information are constructed. The wireless sensor array of complex network is used for educational resources information sampling, and the wireless sensor array of complex network is used for educational resources information sampling. In order to realize the optimal extraction and dynamic compression and reconstruction of educational resources information [5], the statistical information processing method is used for educational resources information fusion processing, and the multi-dimensional node networking model of wireless network is constructed, as shown in Fig. 1.

![Fig. 1. The distribution model of data sampling nodes in complex educational resource information distribution network](image)

According to the distribution of sampling nodes of complex educational resource information distribution network data shown in Fig. 1, the data distribution structure is reorganized. Combined with the spatial area reconstruction method, the data of complex educational resource information distribution network is statistically analyzed, and the multi-dimensional random linear coding technology is adopted [6], information fusion of the complex educational resource information distribution network data is carried out, and the fuzzy iterative state equation of educational resource information sampling is obtained as follows:

\[ A(x) = AJ(x)a(x) + B(1 - b(x)) \] (1)

Let \( A = \{a_1, a_2, \ldots, a_n\} \) be the load of information collection of educational resource information terminal, \( B = \{b_1, b_2, \ldots, b_m\} \) be the category set of educational resource information distribution attributes, \( a_i \) be the dimension of educational resource information compression, data structure reorganization is carried out by adopting a distributed information fusion method to obtain the attribute value of feature distribution.
as \( \{c_1, c_2, \ldots, c_k\} \), and the distributed fusion output of multi-dimensional feature space structure of educational resource information is as follows:

\[
    z_0 = \frac{\sum_{i=1}^{S} z_i d_i}{\sum_{i=1}^{S} d_i^k}
\]  

(2)

Wherein, \( z_0 \) is the correlation estimation value of complex educational resource information distribution network data, and \( z_i \) is the measured value of complex educational resource information distribution network data collected at \( i \) point. According to the adaptive distribution results of educational resource encryption and compression and information coding, a connected undirected graph is adopted to represent the characteristic distribution of educational resource information, wherein \( G = (V, E, W) \) is the topological dimension of educational resource information, wherein \( V = \{v_1, v_2, \ldots, v_N\} \) obtains a statistical analysis model of educational resource information by adopting a multi-dimensional spatial distributed reconstruction method, adopts a differential dynamic compression reconstruction method to fuse educational resource information flows, and the educational resource information scheduling set function is:

\[
    R^j_d(t + 1) = \min \left\{ R_s, \max \left\{ 0, R^j_d(t) + \beta(n_t - |N_i(t)|) \right\} \right\}
\]

(3)

\[
    N_i(t) = \left\{ j : \| x_j(t) - x_i(t) \| < R^j_d; l_i(t) < l_j(t) \right\}
\]

(4)

where \( x_j(t) \) represents the average information entropy in the fuzzy average set \( D \) of educational resource information, describes the sample subset in the \( j \)-th clustering center, and \( l_j(t) \) represents the global weighted value of encrypted transmission of resource information. According to the above sampling results of educational resources information, information reorganization and feature identification are carried out [7–10].

### 2.2 Feature Extraction of Educational Resources Information

A wireless sensing array of a complex network is adopted to sample educational resource information, the collected educational resource information is subjected to feature combination and information automatic extraction [11], and the information entropy of the educational resource information obtained under the constraint condition is satisfied:

\[
    esupt'(D) > \theta
\]

(5)

The fuzzy C-means clustering method is adopted to construct a feature extraction model of complex educational resource information distribution network data, and data fusion processing is carried out according to the feature extraction results. A four-tuple structure is used to describe the information correlation characteristics of educational resource information: \( FP(X_{ij}, P_{ij}, (sup^{k1}(D), \ldots, sup^{kj}(D)), (T_{k1}, \ldots, T_{kj})) \), wherein \( X_{ij} \) is the correlation dimension of the characteristic information flow of educational resource information at the moment, \( T_{ij} \) is the mutual information amount [12]. By
the spatial regional information fusion method, the optimal probability of educational resource information distribution is obtained, which is the fuzzy feature set of educational resource information. By spectral analysis method, the multidimensional reconstruction output of the obtained data is as follows:

\[ x_i^O = x_i^S + K d_i^\text{max} (x_i^L - x_i^S) \]  (6)

Wherein: \( K = 1/\|x_i^L - x_i^S\| \), according to the association rule set of educational resource information, for the calculation, the similarity feature of educational resource information is extracted, and combined with semantic information clustering method, the high-resolution feature reconstruction output of educational resource information is obtained as follows:

\[
f(x) = \text{sgn}\left\{ \sum_{i=1}^{l_1} \alpha_i^+ y_i K(x_i, x) + \sum_{i=1}^{l_2} \alpha_i^- y_i K(x_i, x) + b \right\}
\]  (7)

In the formula, \( \alpha_i^+ \) represents the high-dimensional distribution feature quantity of educational resource information, \( \alpha_i^- \) is the low-frequency component of educational resource information, and \( l_1 \) and \( l_1 \) respectively represent the coupling feature quantity of relevant information. Combined with the fuzzy feature mining method, the gradient vector of network data is obtained as follows:

\[
\text{AVG}_X = \frac{1}{m \times n} \sum_{x=1}^{m} \sum_{y=1}^{n} |G_X(x, y)|
\]  (8)

Where, \( m \) and \( n \) are the geometric feature similarity of educational resource information respectively, \( D \) is set as the spatial distribution domain, and \( T_1 \) is the sampling time delay of educational resource information. According to the above analysis, a feature extraction model of educational resource information is established, and encrypted, compressed and stored according to the distributed detection results of educational resource information features [13].

3 Optimization of Encryption Compression Storage Model for Complex Educational Resource Information Distribution Network

3.1 Compression of Dynamic Data of Educational Resources

On the basis of the above-mentioned construction of the dynamic feature information collection and fuzzy clustering model of educational resource information, and the sampling and feature extraction of educational resource information using the wireless sensor array of the complex network, data dynamic compression is carried out [14], and a educational resource encryption compression storage model based on the complex network and large data analysis is proposed. The output data packets of the feature compression are:

\[
\text{sgn}(z_R^2(k) - R_{MDMMA_R}) = \text{sgn}(z_R^2(k) - \hat{z}_R^2(k))
\]  (9)
\[ \text{sgn}(z^2_R(k) - R_{MDMMA}) = \text{sgn}(z^2_I(k) - \hat{e}^2_I) \] (10)

Wherein, \( \hat{e}^2_R(k) \) represents the observation sequence of ocean resource information flow, \( z^2_R(k) \) is the signal-to-noise ratio in the original training set, \( z^2_I(k) \) is the covariance function, \( \hat{e}^2_I(k) \) is the discrete distribution reconstruction output of ocean resource information, feature combination and automatic information extraction are carried out on collected ocean resource information, metadata structure features of ocean resource information are extracted, probability density statistics of ocean resource information are carried out by combining metadata analysis methods, and information components of dynamic data compression output are obtained as follows:

\[ \eta_{\text{comm}} = \frac{k_1 \cdot l}{E_{\text{comm}}} \cdot (1 - p_{\text{drop}}) \] (11)

Wherein, \( p_{\text{drop}} \) is an association rule distribution function of educational resource information, the output power loss is \( CH_i (i \in C_1) \), the characteristic component of the information difference degree of the educational resource information is extracted, the optimized dynamic compression reconstruction of the educational resource information is realized, and the output is as follows:

\[ f(x) = \text{sgn}\left\{ \sum_{j=1}^{l} \alpha^*_j y_j K(x, x_j) + b^* \right\}, \ x \in \mathbb{R}^n \] (12)

Wherein, \( b^* = y_i - \sum_{j=1}^{l} y_j \alpha_j K(x_j, x_i) \), \( i \in \{ i | 0 < \alpha^*_i < u(x_i)C \} \). According to the above method, the dynamic structural feature values of ocean resource information are extracted, and the data structure is reorganized through dynamic data compression and information perception [15].

### 3.2 Encrypted and Compressed Storage of Educational Resources

Using the distributed fusion method of multi-dimensional feature space structure, the educational resources are encrypted and compressed and the information coding is adaptively distributed, and the fuzzy clustering distribution model of data is obtained as follows:

\[
\begin{align*}
\min_{w, b, \xi} & \quad \frac{1}{2} \|w\|^2 + C \sum_{j=1}^{l} u(x_j) \xi_j \\
\text{s.t.} & \quad y_j ((w \cdot x_j) + b) + \xi_j \geq 1 \\
& \quad \xi_j \geq 0, \ j = 1, 2, \ldots, l
\end{align*}
\] (13)

According to the mutual coupling relationship of educational resource information, high-dimensional phase space reconstruction is introduced, feature combination and automatic information extraction are carried out on the collected educational resource
information, multi-resolution feature quantities of the educational resource information are extracted, and statistical information output by educational resource encryption compression and information encoding is obtained as follows:

$$\frac{\partial u_i}{\partial p_i} = \frac{Gh_i}{\sum_{j\neq i} h_j p_j} + \sigma^2 \left( \frac{1}{1 + \gamma_i} - \beta_{c_1} \right)$$ (14)

The kernel functions of educational resources encryption and compression and information encoding are obtained by using the least square programming algorithm. The optimized programming functions of encryption and compression storage are as follows:

$$\min_{\alpha} \frac{1}{2} \sum_{i=1}^{l} \sum_{j=1}^{l} y_i y_j \alpha_i \alpha_j K(x_i, x_j) - \sum_{j=1}^{l} \alpha_j$$

$$\begin{align*}
s.t. \sum_{j=1}^{l} \alpha_j &= 0 \\
0 &\leq \alpha_j \leq u(x_j) C \quad j = 1, 2, \ldots, l
\end{align*}$$ (15)

Based on fuzzy membership analysis, the output detection probability of dynamic compression and reconstruction of educational resource information is obtained as follows:

$$P_d = \sum_{k=-K}^{K} c_k e^{-j2\pi k T'}$$ (16)

Wherein, $c_k$ represents the multi-information feature distribution set of educational resource information. Then the simplified mathematical model of educational resource encryption and compression and information encoding can be described by the following formula:

$$\begin{align*}
G_1 &= b_{11} a_1 + b_{12} a_2 + \ldots + b_{1n} a_n \\
G_2 &= b_{21} a_1 + b_{22} a_2 + \ldots + b_{2n} a_n \\
&\quad \cdots \cdots \cdots \\
G_n &= b_{n1} a_1 + b_{n2} a_2 + \ldots + b_{nm} a_n
\end{align*}$$ (17)

Wherein, $G_j$ and $G_k$ have strong correlation, $G_j$ represents the oscillation value and interference term of educational resource information, $G_k$ is the principal component of educational resource information. To sum up, the algorithm is designed to optimize the encryption and compression storage model of educational resources.

### 4 Simulation Experiment and Result Analysis

In order to verify the application performance of the method in realizing the encryption and compression storage of the complex educational resource information distribution
network, simulation test analysis is carried out, a phase space model of the encryption and compression storage of the educational resource is established, data analysis is carried out by Matlab, assuming that the sampling length of the educational resource information is 1024, the size of the data is 200, the size of the test set is 120, and the attribute category number of the data of the complex educational resource information distribution network is 65. For the initial frequency $f_1 = 1.52$ Hz of data and the ending sampling frequency $f_2 = 2.43$ Hz, educational resources are encrypted, compressed and stored according to the above parameter settings to obtain a educational resources information test set as shown in Fig. 2.

![Fig. 2. Educational resources information test set](image)

Taking the data in Fig. 2 as the research object, the educational resources are encrypted, compressed and stored, and the educational resources are encrypted, compressed and adaptively allocated for information coding by adopting the distributed fusion method of multi-dimensional feature space structure. The dynamic reconstruction output is shown in Fig. 3.

Analysis of Fig. 3 shows that this method can effectively realize the encryption and compression storage of educational resources, and the dynamic compression performance of data is better. After testing the precision ratio and recall ratio of different methods for encryption and compression storage of educational resources, it is concluded that the precision ratio and recall ratio of this method are increased by 15.3% and 21.8%, respectively. The characteristic compression capability of encryption and compression storage of educational resources using this method is better, the precision of encryption and transmission of resource information is higher, and the precision ratio and recall ratio of educational resource information are improved. Test time cost, the comparison results are shown in Table 1. Analysis of Table 1 shows that the time cost of educational resource encryption and compression storage in this method is relatively short.
Fig. 3. Encrypted compressed storage output

Table 1. Comparison of time expenses (unit: ms)

| Data size/Gbit | This method | Reference [3] | Reference [6] |
|---------------|-------------|---------------|---------------|
| 10            | 13.5        | 34.7          | 54.5          |
| 20            | 15.6        | 83.4          | 64.5          |
| 30            | 23.5        | 96.7          | 83.4          |
| 40            | 27.8        | 110.3         | 95.6          |

5 Conclusions

In this paper, the data detection optimization design of the complex educational resource information distribution network is carried out, and the information reconstruction of the complex educational resource information distribution network is carried out in combination with the compression processing technology of the educational resource information, so as to improve the mining capability of the educational resource information. In this paper, the educational resource encryption compression storage model based on the complex network and large data analysis is proposed. Combined with spatial region reconstruction method, statistical analysis of complex educational resource information distribution network data is carried out, multi-dimensional random linear coding technology is adopted, information fusion of complex educational resource information distribution network data is carried out, fuzzy C-means clustering method is adopted, feature extraction model of complex educational resource information distribution network data is constructed, high-dimensional phase space reconstruction is introduced, feature combination and automatic information extraction are carried out on collected educational resource information, multi-resolution feature quantity of educational resource information is extracted, and educational resource encryption compression and adaptive
allocation and reconstruction of information coding are carried out. The analysis shows that the method of this paper has higher precision and better feature resolution, improves the precision and recall of data, and reduces the processing overhead.

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