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Optimization of Ethnic Music Cultural Exchange Based on Shortest Path Algorithm in the Perspective of Cultural Community Construction

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Abstract Under the background of globalization and multicultural coexistence, the construction of cultural community has become an important path to promote the inheritance and innovation of national culture. This paper takes ethnic music cultural exchange as the research object, and proposes a shortest path model based on the Improved Approximate Neighbor Propagation (IAP) algorithm to optimize the efficiency and structure of cultural communication. The study quantifies the interaction characteristics of nodes and the propagation law by constructing a complex network of ethnic music and cultural communication, and the IAP algorithm solves the limitations of noise interference and modularity resolution to realize the optimization of cultural communication paths. Experiments show that the IAP algorithm has better influence diffusion ability under the DWA model, and the final calculation of influence diffusion in the three datasets is higher than that of the Forward algorithm by 3.4%, 2.6%, and 2.7%, respectively, and the actual number of activated nodes is improved by 3.4%, 3.4%, and 2.5%, respectively. The improved IAP algorithm is used to optimize the network influence problem, and the average shortest path length is only 1508.77 when G=2000, which provides theoretical support and practical solutions for the universal communication and cross-regional mutual appreciation of ethnic music culture.

Index Terms ethnic music cultural exchange, nearest neighbor propagation algorithm, shortest path, complex network analysis

I. Introduction

Cultural community refers to a cultural community where multiple cultures coexist with Chinese culture as the core [1]. It refers to the inclusion and integration of the cultural achievements of various nationalities on the basis of Chinese culture, forming a multicultural integration, mutual respect and harmonious development of the whole [2], [3]. Constructing a Chinese cultural community means, first of all, actively absorbing and integrating the cultural elements of other nationalities on the basis of inheriting Chinese culture to form a pluralistic and integrated cultural structure [4]-[6]. The Chinese cultural community also means that in the process of cultural development, we should adhere to the concept of openness, tolerance and mutual respect, promote exchanges and mutual learning among various cultures, and promote the harmonious development of cultural differences and coexistence [7]-[9]. Constructing the Chinese cultural community also means breaking down the barriers of ethnicity, geography and region, strengthening cultural communication and exchanges between all regions of the country, promoting the construction and sharing of cultural resources around the country, and realizing the sense of community and values of Chinese culture [10]-[13]. And ethnic music culture, as an important component of the cultural community, contributes to the integrity of the community [14].

Ethnic music contains the oldest unique cultural qualities of human civilization, has the important role of indicating the significance of cultural manifestation, and is an important element in the construction of the pluralistic qualities that characterize the pluralistic unity of the Chinese nation [15]-[17]. Chinese culture needs the nourishment of music, and the cultural diversity of the community is inseparable from the intermingling, coexistence and unity of various ethnic musical cultures [18], [19]. The pluralistic music culture containing colorful patterns and rich connotations of various ethnic groups is the real existence of the community music, which is the essential characteristic of the Chinese music culture [20], [21]. Under the perspective of cultural community construction, the optimization of ethnic music culture exchange is of great significance in strengthening the national cultural identity and community consciousness, promoting the sustainable development of cultural ecology, and enhancing the right of international cultural discourse [22]-[24].

In this paper, we first analyze the innovation-driven characteristics and practical mutual learning mechanism of ethnic music communication in the view of cultural community, and reveal the main features of cultural communication. It proposes an improved nearest neighbor propagation algorithm with modularity optimization, which breaks through the limitations of traditional algorithms in terms of sensitivity to noise centroids. A cultural communication network of 56 ethnic groups is constructed, and the network characteristics and propagation laws are investigated based on complex network analysis. Compare the experimental results under the propagation probability model DWA, and verify the performance level of the algorithm on network impact maximization. Analyze the node degree distribution of individual users, and explore the effectiveness of IPA algorithm in optimizing the communication path and enhancing the cultural popularity.

II. Main features of ethnic music cultural exchanges in the context of cultural community building

(1) Innovative development, led by the spirit of the times

Under the perspective of cultural community, one of the characteristics of ethnic music cultural exchange is to insist on innovation and development, and to lead the development of ethnic music cultural exchange with the spirit of the times. In the practice of exchange, innovative development refers to the need to inherit the spiritual and cultural kernel of traditional folk music, and to understand its artistic characteristics and national cultural connotations. On this basis, it is necessary to integrate the concept of innovative development and mainstream aesthetic needs of modern society, modernize and re-create the national music culture, give the national music culture the spirit of the times of cultural inheritance and innovation, and take this spirit of the times as an important driving force to lead, dig deep into the national spiritual and cultural connotation, and give the national music cultural exchanges a national background and highlight national self-confidence. The spirit of the times is also an important driving force to dig deep into the spiritual and cultural underpinnings of the nation, to give national music and cultural exchanges a national undertone, to show the confidence of the nation, and to push forward the modernization and development of national music and cultural exchange.

Specifically, under the influence of this zeitgeist-driven leadership, ethnic music cultural exchanges will pay more attention to the integration of local music elements with modern technology. Through the use of modern technology, the traditional music elements are networked and digitized, and on the basis of not changing the essential connotation of music culture, the communication channels of culture are extended vertically, and the digital interactive interface is used to promote the music works, so that the national music culture can penetrate into the people's masses in a practical way. At the same time, such modernized national music and cultural works have both distinctive national characteristics and modern mainstream aesthetic characteristics, which can drive the national music and culture to the world stage more confidently, bring out the vitality of the times, and play an important role in cultural exchanges.

(2) Practical Exchanges and Cultural Mutual Recognition

Under the perspective of cultural community, one of the characteristics of ethnic music cultural exchange is to take practical exchange as an important idea, and to promote the mutual understanding of ethnic music culture in cultural exchange. Considering that cultural self-confidence needs to be reflected and strengthened in the practice of cultural exchanges, in the process of ethnic music cultural exchanges, it is necessary to effectively promote cultural exchanges in the form of performances, professional seminars, network publicity activities and other forms of practical exchanges, so as to comprehensively demonstrate the charm and cultural connotation of unique ethnic arts, and thus to strengthen the cultural self-confidence in the process of practical exchanges. This form of practical exchange not only promotes cultural understanding between different ethnic groups, but also indirectly promotes the integration and development of ethnic music culture, and also provides a broad platform for ethnic music culture exchange to learn from each other and learn from each other. Ethnic musicians can share their ethnic music creation concepts and performance skills on the exchange platform, constructing an atmosphere of mutual learning and common progress, and jointly improving the level of ethnic music creation and performance. At the same time, in this atmosphere of cultural exchanges, using cultural mutual understanding as the index of practice, we can effectively carry out the practice concept of using the West for China, neutralize the impact of foreign (other ethnic) music cultures on our own music cultures, and reduce the xenophobia of the cultures themselves. In conclusion, this form of strengthening cultural self-confidence in practice and promoting cultural mutual understanding and ethnic music culture exchange can not only promote cultural understanding between different ethnic groups, but also provide a platform for ethnic musicians to share their music and culture halls, which has the practical significance of promoting the common progress of diversified music cultures.

III. Design of shortest path method based on IAP algorithm

III. A. Concepts related to the shortest path problem

Definition (1): graph

A graph is usually denoted by the letter G, which is a binary set, i.e., $G=(V,E)$. where V denotes the set of vertices, E denotes the set of edges, v denotes a vertex and is an element in the set of vertices V, e denotes an edge and is an element in the set of edges E, and the element e is also a binary, i.e., $e=(x,y)$, where $x \in V$, $y \in V$.

Definition (2): Directed and Undirected Graphs

Directed graph: the edges formed by any two vertices, except for isolated vertices, are directional. Usually denoted as $G=(V,A,\psi)$, $G=(V,A,\psi)$ is an ordered triple. where V denotes the set of vertices and $\forall v_i, v_j \in V$, A denotes the ordered set of vertex pairs, and ψ denotes the association function. An example of a directed graph is shown in Figure 1, where a, b, c, d, e, $f \in V$, ordered vertex pairs $<a,c>$, $<b,c>$, $<c,d>$, $<c,e>$, $<d,f>$, $<e,f> \in A$ denote edges with a direction, e.g., a is the starting point and c the ending point in $<a,c>$. is the end point.

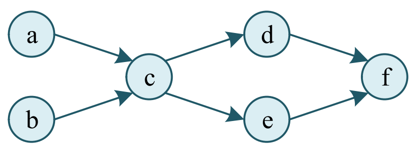


Figure 1: Example of a directed graph

Undirected graph: edges formed by any two vertices, except isolated vertices, are not directional. Usually denoted $G=(V,B)$, $G=(V,B)$ is an unordered binary. Its V denotes the vertex set and for $\forall v_i, v_j \in B$ denotes the unordered set of vertex pairs. An undirected graph example shown in figure 2, where a, b, c d, e, $f \in V$, ordered vertices to (a,c), (b,c), (c,d), (c,e), (d,f), $(e,f) \in B$ said do not have the direction of the edge, For example, in (a,c), a can serve as either the starting point or the ending point.

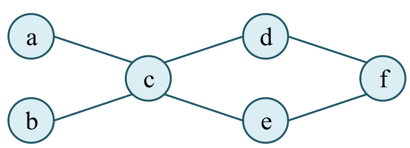


Figure 2: Example of an undirected graph

Definition (3): connected graphs and connected components

In graph theory, we define a graph $G=(V,E)$ for $\forall v_i, v_j \in V$ with paths connecting from vertex v_i to vertex v_j, then we call the graph a connected graph, an example of a connected graph is shown in Figure 3. A very large connected subgraph of a graph is called a connected branch of the graph G. There is only one connected branch of a connected graph i.e. Figure 3 itself.

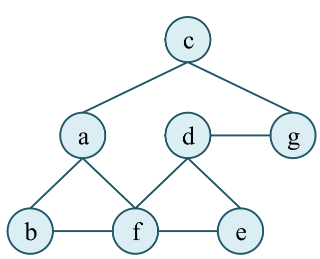


Figure 3: Example of a connected graph

A graph is said to be non-connected if there exists a vertex v_i unreachable to a vertex v_j in the graph $\exists v_i, v_j \in V$, and an example of a non-connected graph is shown in Figure 4. A non-connected graph has multiple connected branches, such as $\{(a,b),(a,c),(b,c)\}$, and $\{(d,e),(d,f)\}$ are the 2 connected branches of the non-connected graph 4.

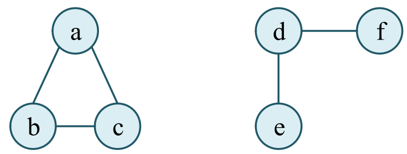


Figure 4: Example of a non-connected graph

Definition (4): cut point

In a connected undirected graph $G=(V,E)$, if a vertex $v_i(v_i \in V)$ is deleted from the connected undirected graph G, the graph G is no longer connected and the number of connected branches increases, then v_i is a cut point of the graph G. An example of an undirected connected graph containing cut points is shown in Figure 5. In $G=\{(a,c),(b,c),(c,d),(c,e),(e,f),(d,f)\}$, when the vertex c and the edges connected to the vertex c are deleted, the graph G is no longer connected and the connected branches become $\{a\}$, $\{b\}$, $\{(e,f),(d,f)\}$, then the vertex c is said to be a cut point of the graph.

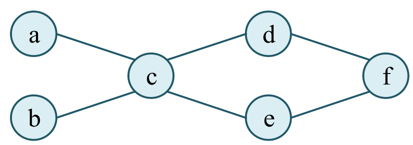


Figure 5: Example of an undirected connected graph with cut points

III. B. Neighborhood Propagation Algorithm Improvement Strategy

III. B. 1) Overview of the AP algorithm

The basic idea of AP clustering algorithm is similar to k-means clustering algorithm. The idea of AP clustering algorithm is to first find some cluster centroids and then group the nodes other than the cluster centroids into the module where the one cluster centroid that is most similar to it is located. The advantage of the AP clustering algorithm is that it does not need to specify the number of association clusters in advance, and sets a priority parameter $s(i,i)$ for each node object, which indicates the likelihood of a node object i to be the centroid, and nodes with larger priority values are more likely to be the centroids of the module clusters. In the absence of a priori knowledge of the clustering centroids, the priority of the clustered node objects is considered to be the same. Assuming that $V=\{v_1,v_2,\ldots,v_N\}$ denotes the set of graph vertices, and that $\sigma(v_i)$ denotes the labeling of the class of the association module to which the centroid that is the most similar to the node v_i belongs, the goal of AP is to find the optimal mapping function σ to maximize the energy function:

$$E[\sigma]=\sum_{i=1}^{N} s\left(v_i, v_{\sigma(v_i)}\right) \tag{1}$$

where $s(v_i,v_j)$ represents the similarity of vertices v_i and v_j. Here $s(v_i,v_j)$ is set as the opposite of the distance values of v_i and v_j, and the initial value of $s(v_i,v_j)$ is set as the median of the input similarity.

The AP clustering algorithm finds the centroids of association clusters and minimizes the energy function by iteratively exchanging messages between clustered node objects, which are classified into trustworthiness messages and availability messages. The trustworthiness message $r(v_i,v_k)$, which is a message from the clustering node v_i to the candidate centroid v_k, which measures how likely it is that v_k will be the centroid of v_i; and the availability message $a(v_i,v_k)$, which is the opposite of $r(v_i,v_k)$, which is a message from the candidate centroid v_k to the clustering node v_i. That tells v_i how much evidence has been shown that other cluster node objects have supported v_k and chosen v_k as their centroid. The initial values of both the trustworthiness message and the availability message are set to 0, and the final values are solved iteratively by the following formula.

$$r(v_i, v_k) \leftarrow s(v_i, v_k) - \max_{k' \neq k} \left\{ a(v_i, v_{k'}) + s(v_i, v_{k'}) \right\} \tag{2}$$

$$a(v_i, v_k) \leftarrow \min \left\{ 0, r(v_k, v_k) + \sum_{i' \notin \{i,k\}} \max\{0, r(v_{i'}, v_k)\} \right\} \tag{3}$$

$$a(v_k, v_k) \leftarrow \sum_{i' \neq k} \max\{0, r(v_{i'}, v_k)\} \tag{4}$$

When the center point no longer changes or the maximum number of iterations is reached and the iterative process ends, the vertex v_i selects the vertex $v_{\sigma(v_i)}$ as the center point and $\sigma(v_i)$ needs to satisfy the following conditions:

$$\sigma(v_i) = \arg\max_k \left\{ a(v_i, v_k) + r(v_i, v_k) \right\}, k = 1, 2, \ldots, N \tag{5}$$

III. B. 2) Improvement strategies

The resolution problem of modularity has always been a topic of concern, because only relying on modularity sometimes fails to dig out the correct association module structure. AP clustering algorithm is a better performance algorithm, but it often identifies some "noise" centroids when identifying the correct association structure of complex networks. In order to overcome these defects, this paper proposes a new algorithm IAP, which is based on the idea of the shortest path, the maximum modularity strategy is integrated into the nearest-neighbor propagation algorithm, which not only avoids the problem of the discriminative limit, but also solves the problem of "noise" centroids of the AP algorithm. The specific flow of the algorithm is as follows:

(1) Construct the non-similarity distance matrix. Given a network graph structure $G = (V, E)$, G denotes a network graph, V denotes the set of all nodes (vertices) in the graph, and E denotes the set of edges between all nodes. The node similarity index is first applied to construct the similarity matrix S between all nodes, and then the non-similarity ρ_{ij} of the edges connecting nodes v_i and v_j is calculated by using Equation (6).

$$\rho_{ij} = f(s_{ij}) \tag{6}$$

where s_{ij} is the similarity measure between node v_i and node v_j, and $f(x)$ is a decreasing function, e.g., $f(x) = \exp(-\alpha x)$ or $f(x) = \beta / x$, and α and β are constants, and this paper employs inverse proportional functions (i.e., adopts the latter) to transform the nodes' similarity values into non-similarity values.

(2) Identify the initial set of centroids. The distance matrix $D = [d_{ij}]_{n \times n}$ is used as the input of the nearest neighbor propagation algorithm (where d_{ij} denotes the similarity metric or distance between node i and node j, and there are a total of $n \times n$ metrics between n nodes, which form a similarity matrix D), and the initial state centroids are identified. set $\{v_{\sigma(v_1)}, v_{\sigma(v_2)}, \ldots, v_{\sigma(v_m)}\}$, $\sigma(v_i)$ denotes the labeling of the class of the association module to which the centroid that is the most similar to node v_i belongs, and $v_{\sigma(v_i)}$ denotes this association module's centroid. Then, the value of the sum of the trustworthiness and availability of the center points is calculated, and sorted from small to large, and a set of candidate center points $Z = \{z_1, z_2, \ldots, z_\lambda, \ldots, z_m\}$, z_λ represents the center point of the first λ community module, and Z represents the set of m community center points.

(3) Obtain the classification of associations using modularity maximization. First define the bipartition of the set of candidate centroids $Z = \left\{z_1, z_2, \ldots, z_\lambda, \ldots, z_m\right\}$, i.e., without changing the order of the sets, they are divided into the set of noisy centroids $G_1 = \left\{z_1, \ldots, z_i\right\}$ and the optimal centroid set $G_2 = \left\{z_{i+1}, \ldots, z_n\right\}$ into two classes, and call G_1, G_2 the bipartition of them. . Apply the exhaustive method to get different bipartitions, for each kind of bipartition, calculate the shortest paths from other nodes to the center point, according to the principle of the smallest path is optimal, i.e., $\left\{v \in C_1, D(v, z_1) \leq D(v, z_2)\right\}$, C_1 indicates the center point z_1 the association where it is located, $D(v, z_1)$ denotes the distance from the point v to the center point z_1, if the distance from the point v to the center point z_1 is smaller than the distance from the point v to the center point z_2, then the point v is attributed to the

association C_1. Then the corresponding association structures are divided according to the above respectively, and the module degree Q of each association structure is calculated. The optimal modularity index is used as the objective function to finalize the association modular structure of the network.

IV. Research on the optimization of ethnic music cultural exchange based on the IAP algorithm

Under the dual context of global cultural integration and local cultural revitalization, ethnic music culture, as an important carrier of the cultural community, has a direct impact on the effectiveness of its communication on the construction of cultural identity and community cohesion. Currently, ethnic music and cultural exchanges are faced with two core contradictions: one is the lack of modern adaptability of traditional music forms, and the other is the structural imbalance of cultural communication networks. The former is manifested in the split between the cultural core and the aesthetics of the times, while the latter is reflected in the dependence of the communication path on the center node and the low accessibility of the weakly connected nodes. Existing research focuses on the mining of cultural connotations or the application of a single technology, but lacks a systematic exploration of the dynamic characteristics of the communication network and algorithmic adaptability. This study constructs a method for the optimization of ethnomusicology cultural communication under the perspective of cultural community through the dual innovation of theory and technology.

The construction of the complex network of ethnic music cultural communication takes the theory of cultural community as the guiding framework, and adopts the social network analysis method to structurally characterize the music cultural interaction behaviors across regions and ethnic groups. The traditional music repertoire, performing groups and inheritors of 56 ethnic groups in China are selected as the basic nodes, and the interaction edges between the nodes are established based on historical documents, field surveys and data mining on digital platforms, forming a weighted directed network with 12,347 nodes and 387,215 edges.

IV. A. Analysis of Ethnic Music Cultural Communication Networks Based on Complex Networks

IV. A. 1) Network characteristics

In order to reveal the topological characteristics of the network, the in-degree network and out-degree network are constructed separately. The degree distribution is used to characterize the nodes, which represents the probability distribution of the degree of a network node, denoted by the function p(k), which is the probability that the degree of a randomly selected node is exactly k. Since the node degree reflects the direct connectivity of an individual to other members, the agglomeration coefficient reflects the closeness of links between circles centered on a particular node. Therefore, in general, a high degree value of a node does not imply that the point has a high agglomeration coefficient.

The in-degree network reflects the intensity of cultural input received by each node, and its node in-degree value corresponds to the absorption capacity of other ethnic music elements; the out-degree network quantifies the cultural output effectiveness of the nodes, and the out-degree value characterizes the radiation range of a specific music tradition. The relationship between the aggregation coefficients and node degrees of the in-degree network and out-degree network of the complex network of ethnic music cultural exchange is shown in Figure 6. The number of nodes with larger degree values is smaller, and the aggregation coefficient of these nodes is lower. There is a negative correlation between the clustering coefficient and degree, i.e., nodes with low degree values have higher clustering coefficients, indicating that there is significant clustering of nodes with low degree values.

The relationship between agglomeration coefficient and degree distribution shows that degree is not positively correlated with the degree of aggregation, but there is also a “long tail phenomenon” of degree distribution in complex networks, i.e., “degree-degree” correlation, which depicts the relationship between nodes with large degree values and nodes with small degree values in the network. A network is degree-degree positively correlated if nodes with large degree values tend to connect to nodes with large degree values. If nodes with large degree values tend to connect with nodes with small degree values, the network is degree-degree negatively correlated. In this paper, we use the Pearson correlation coefficient of the nodes at both ends of the edge to describe the degree-degree correlation of the network. The degree correlation coefficient of the in-degree network is -0.301, and that of the out-degree network is -0.329. The degree correlation coefficients of the two networks are less than 0, which indicates that the networks are heterogeneous, i.e., nodes with small degree values tend to be connected with nodes with large degree values, and newly added individuals tend to be connected with individuals with large degree values.

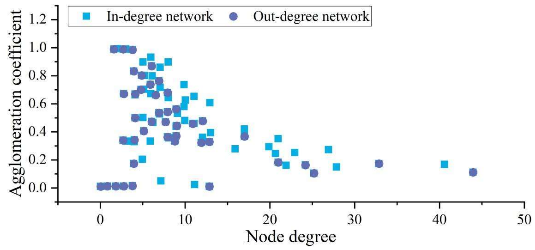


Figure 6: Relationship between clustering coefficient and node degree

IV. A. 2) Dissemination patterns

Calculate the relationship between the density of infected individuals ρ and the effective contagion rate λ of the public opinion communication of the sample microblogging network. In order to further compare the difference in the transmission law between the uniform network and the ethnomusicocultural communication network in this paper, the transmission laws of the small-world network and the ethnomusicocultural communication network under the same average degree condition are compared, and a comparison of the transmission laws is shown in Figure 7. The contagion rate of the ethnic music culture exchange network continuously and smoothly transitions to zero, indicating that there is no propagation threshold for the ethnic music culture exchange network with scale-free characteristics. For the ethnic music culture communication network, as long as the contagion rate is > 0, the information can be disseminated and eventually maintained in a stable state, which also reflects the vulnerability of the ethnic music culture communication network to information dissemination from one side.

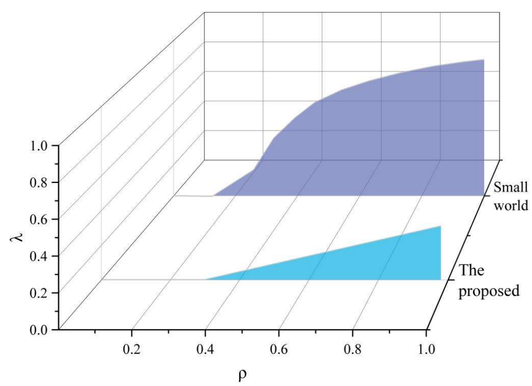
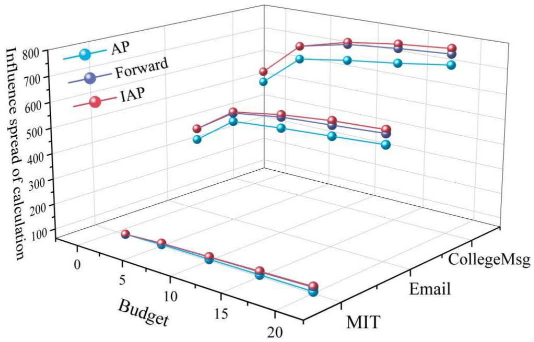


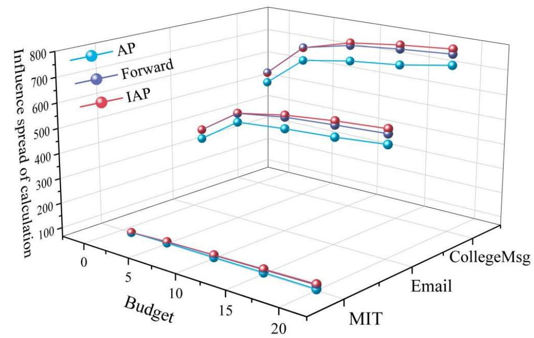
Figure 7: Comparison of propagation rules

IV. B. Analysis of the effectiveness of the IAP algorithm

This section compares the experimental results under the propagation probability model DWA. The influence spread and the actual number of activated nodes computed on Email, CollegeMsg, and MIT datasets under the DWA model are shown in Fig. 8(a~b), respectively. It can be clearly seen that the IAP algorithm has better influence spreading ability under the DWA model compared with the AP algorithm and the mainstream algorithm Forward. The results of the IAP algorithm and the Forward algorithm are relatively close to each other, and both of them are better than the AP algorithm. The IAP algorithm's final computed influence spreading in the three datasets is higher than that of the Forward algorithm by 3.4%, 2.6%, and 2.7%, respectively and the actual number of activated nodes is improved by 3.4%, 3.4%, and 2.5%, respectively. Even though 25,000 rounds of Montecarlo simulation are used in this section to evaluate the actual propagation impact, the curve in Fig. 8(b) is also not very smooth, which is due to the fact that the number of simulation rounds should theoretically be infinite, and it is obviously unrealistic to set the parameters in this way. Due to the insufficient number of simulation rounds and the asymmetry of random number selection in the experiment, the actual number of activated nodes obtained by the Montecarlo simulation is a bit higher than that calculated by Eq. But the trend of the curves is the same, which can be seen from the comparison of the experimental results of the different datasets in Fig. 8. Then analyze the difference between the computed impact propagation and the actual impact propagation, which can be seen from Fig. 8(b), the actual number of activated nodes fluctuates with the change of the computed impact propagation curve, because the computed impact propagation is theoretically the average expected value of the activated nodes.



(a) Calculating influence propagation



(b) The actual number of activated nodes

Figure 8: Comparison of algorithm performance

IV. C. Application effects

The improved IAP algorithm is used to optimize the network influence problem. The distribution of individual user node degree for N=2000, k=50, X=15 is shown in Fig. 9. It can be seen that when the number of clusters reaches 2000, the node degree no longer obeys a power rate distribution. The more the number of groups, the smaller the average shortest path length of the network is, and when G=2000, the average shortest path length is only 1508.77. That is to say, the optimization of the IAP algorithm significantly increases the contact pathway before the person and the person, which leads to a smaller interval between the person and the person. The experiment verifies that the IAP algorithm enhances the accessibility of the weakly connected nodes while maintaining the network heterogeneity, which provides structural support for the inclusive dissemination of ethnic music culture.

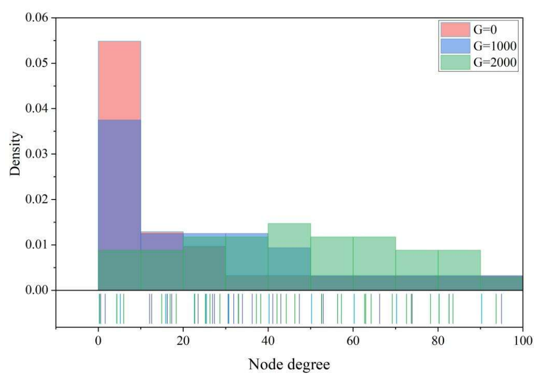


Figure 9: Distribution of individual user node degree

V. Conclusion

This paper constructs a systematic framework for the optimization of ethnomusicology cultural exchange under the perspective of cultural community through the dual innovation of theory and technology.

The degree correlation coefficient of the in-degree network of ethnic music cultural exchange network is -0.301, and that of the out-degree network is -0.329. The degree correlation coefficients of the two networks are less than 0, which indicates that the networks are heterogeneous networks. There is no propagation threshold in the ethnomusicocultural communication network, as long as the contagion rate is > 0, the information can be spread and eventually maintained in a stable state, reflecting the vulnerability of the ethnomusicocultural communication network to information dissemination.

Comparing the calculated influence spread and the actual number of activated nodes on Email, CollegeMsg, and MIT datasets under the DWA model, the IAP algorithm has a better influence diffusion ability under the DWA model compared with the AP algorithm and the mainstream algorithm Forward. The results of the IAP algorithm and the Forward algorithm are closer, and are both superior to the AP algorithm. the IAP algorithm is better than the AP algorithm on the three datasets the final calculated influence spread is higher than Forward algorithm by 3.4%, 2.6%, and 2.7%, respectively, and the actual number of activated nodes is improved by 3.4%, 3.4%, and 2.5%, respectively, which experimentally verifies the effectiveness of the IAP algorithm in maximizing the influence of the network. The improved IAP algorithm is used to optimize the network influence problem. When the number of clusters reaches 2000, the node degree no longer obeys the power rate distribution. The more the number of clusters, the smaller the average shortest path length of the network is, and when G=2000, the average shortest path length is only 1508.77. The optimization of the IAP algorithm significantly increases the contact paths before people, which leads to a smaller interval between people.

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