Hindawi
Mobile Information Systems
Volume 2022, Article ID 9168899, 8 pages
https://doi.org/10.1155/2022/9168899

Research Article

Multicriteria Recommendation Method of Tourist Routes Based on Tourist Clustering

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Received 13 July 2022; Revised 20 September 2022; Accepted 26 September 2022; Published 10 October 2022

Academic Editor: Santosh Tirunagari

A multicriteria recommendation algorithm for tourist routes under the multidimensional expanded spatial grid structure model based on fuzzy C-means clustering of tourist preferences is proposed. The purpose of the proposed structure is to improve the multicriteria intelligent recommendation ability of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle. The multidimensional enlarged spatial grid structure model of the well-known tourist core circle is used to develop the tourist correlation model of travel routes under the restricted sample training. Under the popular traveler core circle's multidimensional enlarged spatial grid structure framework, the mixed kernel use and global kernel use are created to extract the correlation characteristics of tourist route recommendation. Under the multidimensional enlarged spatial grid structure model of the well-known tourist core circle, the adaptive learning of tourist route selection is carried out using the hybrid particle swarm algorithm. To manage the convergence of the suggestion process, maps of logistical chaos are employed, utilizing culture's universalism and ergodicity resources and examining the aesthetic resources along tourism routes. The simulation results demonstrate that the multidimensional extended spatial grid structure model's tourism route information recommendation accuracy is decent, and a solid swarm intelligence junction is observed in this analysis, preventing tourism route recommendations from settling for the local optimal solution and enhancing their intelligence and global stability.

1. Introduction

With the development of tourism, to improve the recommendation level of tourist routes under the multi-dimensional expanded spatial grid structure model of the core circle of popular tourism, to enrich the research content of the destination tourist routes network of the core circle of popular tourism, and to innovate the research perspective of influencing factors. Due to the usual spatial aspects of tourism, it is crucial to understand the network properties of destination tourism routes in order to coordinate the interaction between people and the environment. In the past five years, the academic research on the spatial structure characteristics of tourist route network has gradually increased, but the research scale mainly focuses on the macro scale, while the research on the city scale is less, and the research on the influencing factors is still in the exploratory stage. This paper uses Nanjing as an example to analyse the spatial structure characteristics of city-scale tourist route networks. It does so by using text data from travel notes, and it does so in a novel way by incorporating tourists' emotions into the study of factors that influence tourist route networks. This enriches the research materials of meso-scale tourist route network structures, encourages the integration of emotional geography and tourism disciplines, and offers a fresh viewpoint for both fields. The resource scheduling and tailored recommendations of tourist routes are taken out using the design approach in conjunction with the popular tourist core circle's multidimensional extended spatial grid structure model. Under the multidimensional enlarged spatial grid structure model of the well-known tourist core circle, the resource scheduling capacity of tourist routes and the prospective feature extraction capacity of tourists are increased [1]. According to historical visit records and preferences, personalized resource optimization scheduling is done for complex and diverse online learning resources in the tourism routes under the multidimensional expanded spatial grid structure model of the popular tourism core circle. This is done to promote knowledge utilisation and improve the ability of the tourism routes to interact dynamically under the multidimensional enlarged spatial grid structure model [2]. Promoting the best design of the tourism routes under the multidimensional enlarged spatial grid structure model of the popular tourism core circle requires a thorough understanding of the personalized intelligent recommendation algorithm for those routes. Sanghoon Kang and Jaskon Vilam analyzed the spatial network structure characteristics of tourist attractions in Seoul, South Korea by using the data of China's Free and Independent Tourists (FIT), and put forward optimization measures. Rosario D'Agata, Lisa Rimon and Sofei Sili analyzed the data of tourists departing from airports and ports in major cities in Sicily, studied the regional spatial network structure, and explored the tourism flow pattern in the region. Manllan and Silin explored the tourism business contact of isolated communities by analyzing the characteristics of tourism route spatial network. Sang-Hyun Lee and Linshoon analyzed the spatial layout of tourist routes in 43 villages in Yang Town and Quan Lam Town, and measured them with concentration indicators, so as to verify the effectiveness of comprehensive rural tourism management. Liu Hongying and Yan Tiantian took the tourist routes as the breakthrough point and used the collected relevant data to study the structural characteristics of the tourism spatial network in the Pan-Beibu Gulf region. Wang Jinying and Wiliion analyzed the geographical distribution of inbound tourist flows in Asia and studied the spatial distribution of tourist routes from Asian countries to China. Zhou Huiling and Wang wuqiang, taking a travel itinerary as a sample, made an in-depth analysis of the characteristics of Hunan's tourism spatial network and put forward targeted plans to optimize traffic routes and build city image. Chen Hao and Chen Mengji studied the spatial network structure characteristics of tourist destinations in the Pearl River Delta region from the macroscopic point of view of urban tourist groups and put forward the idea of optimizing the spatial structure. Intelligent particle swarm algorithms, association rule mining algorithms, data clustering approval algorithms, fuzzy PID recommendation algorithms, etc. The primary ones are found in traditional approaches for personalized recommendation of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circles. According to the multilevel multidimensional expanded spatial grid structure model of the popular tourist core circle, the topological structure of tourist routes is optimized. Considering information distribution and recommendation task features [3–5], a data clustering center for personalized recommendation of tourist routes in the multidimensional expanded spatial grid structure model of popular tourist core circle is established, and the algorithm for recommendation of tourist routes in the multidimensional expanded spatial grid structure model of a popular tourist core circle is designed by using the association rules mining method in order to enhance the tourist routes' ability to express themselves uniquely within the multidimensional enlarged spatial grid structure model of the main tourist core circle. Related literature have designed the recommendation algorithm of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circles and achieved certain research results. The recommendation algorithm of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circles is proposed, taking tourist behaviour value, tourist consumption value, and loyalty of tourist routes under the model as independent variables [3]. The fuzzy decision-making model of tourism route recommendation under the multidimensional expanded spatial grid structure model of popular tourism core circle is established, and the optimization design of tourism route recommendation model under the multidimensional expanded spatial grid structure model of popular tourism core circle is carried out by combining the association mining method. However, the calculation cost of this method is large, and the real-time performance of tourism route recommendations under the multidimensional expanded spatial grid structure model of popular tourism core circle is not good. In [4], on the basis of difference factor evaluation and intelligent PSO, a suggestion and recommendation algorithm for tourist routes under the multidimensional enlarged spatial grid structure model of popular tourist core circle is provided. It is established that tourist routes have synchronous tags under the multidimensional enlarged spatial grid structure model of the well-known tourist core circle, and it is extracted that these tourist routes have linked attribute features from this model. Analyze the relationship between the level of group interaction and the effectiveness of recommendations, and implement personalized travel route recommendations using a multidimensional enlarged spatial grid structure model of a well-liked tourist core circle. The procedure of selecting tourist routes using this technology is not clever on the multidimensional enlarged spatial grid structure model [5].

This research suggests a multicriteria recommendation method for tourist routes based on fuzzy C-means clustering of visitors' preferences within the multidimensional enlarged spatial grid structure model of a well-liked tourist core circle in order to address the aforementioned issues. Firstly, using a small sample of training data, a tourist correlation model of tourist routes is created using a multidimensional expanded spatial grid structure model of a popular tourist core circle. Then, using this model, to extract the correlation properties of the information about the recommended tourist routes, global and hybrid kernel functions are developed. Finally, the multidimensional enlarged spatial grid structure model of the popular tourist core circle is used to carry out adaptive learning of the suggested tourist routes. Then, using logistic chaotic mapping, the suggestion process' convergence is controlled, and the universality and ergodicity of the tourist routes' cultural and scenic resources are examined. The multidimensional expanded spatial grid structure model of the popular tourist core circle is used in conjunction with the gradient algorithm to carry out particle swarm evolution and adaptive optimization of tourist route recommendation, and this results in the realization of swarm intelligence recommendations of tourist information of tourist routes. Finally, the simulation analysis shows that this method is superior in improving the personalized intelligent recommendation ability of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle.

2. Tourism Route Recommendation Information Model and Associated Feature Extraction

2.1. Recommended Information Transfer Model of Tourist Routes. Under the multidimensional enlarged spatial grid structure model of the popular tourist core circle, a parallel recommendation algorithm is applied. This algorithm is used to obtain prospective presents and mine tourist data in order to accomplish personalized recommendation and feature identification of tourist routes [6]. Under the multidimensional enlarged spatial grid structure model of the well-known tourist core circle, associated components of the tourist route approval data are extracted using a hybrid kernel function and a global kernel function. Self-organizing nonlinear mapping creates the information transmission space for a tourist route under the grid structure model of the multidimensional expansion space of the popular tourism core circle, and the fuzzy decision function of the recommendation information for the tourist route is obtained using a small sample of training data [6]. The recommendation data for a tourist route under the grid structure model of the multidimensional expansion space of a well-known tourist core circle is mapped to high-dimensional feature space using fuzzy decision and intelligent swarm algorithms. Under the multidimensional enlarged spatial grid structure model of the widely used tourist core circle, it is anticipated that the suggested training sample set of tourist routes isΦ: $x \in R^n \longrightarrow F$, where the recommendation model's input vector is personalization factor quantity, $\{(x_1, y_1), (x_2, y_2), \cdots, (x_n, y_n)\}$ is the goal measurement value for individualized advice, and $x_i \in R^n$ is the total sample size. Combined with the algorithm of association rules mining, the actual task of intelligent suggestion of tourist routes under the grid structure model of multidimensional expansion space of popular tourist core circle is obtained as follows:

$$\begin{aligned} &\text{minimize}\frac{1}{2}\|w\|^2 + C\sum_{i=1}^{n}\left(\xi_i + \xi_i^*\right)\\ &\text{subjectto} y_i - \left(w'\Phi\left(x_i\right) + b\right) \le \varepsilon - \xi_i\\ &\left(w'\Phi\left(x_i\right) + b\right) - y_i \le \varepsilon - \xi_i^*\\ &\xi_i, \xi_i^* \ge 0, i = 1, 2, \cdots, n; C > 0, \end{aligned} \tag{1}$$

wherein ξ_i and ξ_i^* represent the variables in association rules and semantic ontology properties. In order to execute the punishment control of wrong samples, The cost factor for suggestions is based on the algorithm for generalized learning and applied to the process for suggestion method for adaptive learning. The following describes how the particle swarm optimization control is used to produce the difference function of a customized recommendation:

$$f(x) = \sum_{i=1}^{n}\left(\alpha_i - \alpha_i^*\right)K\left(x_i, x_j\right) + b, \tag{2}$$

where α_i and α_i^* are suggested attribute values and how many template categories there, which are symmetric kernel functions satisfying Mercer conditions, and $K(x_i, x_j)$ is the recommended threshold.

Under the multidimensional expanded spatial grid structure model of the popular tourism core circle, to create a hybrid kernel function for tourism route recommendation, each and every information tuple's property course set is produced, and the local kernel function (RBF kernel function) and global kernel function (polynomial kernel function) are employed as controllers of taking decision functions. Its expression is:

$$K_{\min} = \beta K_{\text{poly}} + (1 - \beta)K_{rbf}, \beta \in (0, 1), \tag{3}$$

wherein $K_{\text{poly}} = [(x \cdot x_i) + 1]^2$ represents the kernel function of multidimensional expansion space, and $K_{rbf} = \exp(-\gamma\|x - x_i\|^2)$ displays the RBF kernel function of trust reliability of tourist routes under the grid structure model of multidimensional expansion space of a well-liked tourist core circle. K_{rbf}, is to modify the impact of two kernel functions on the weight coefficient, which is the mixed kernel function as a whole. As a result, the multidimensional expanded spatial grid structure model of the popular tourist core circle is used to construct the information transmission model of tourist route recommendation. Tourist feature mining and personalized recommendation design of tourist routes under this model are carried out by combining the particle swarm optimization method [7].

2.2. Extraction of Correlation Features of Tourist Route Recommendation Information. Correlation properties to extract tourist route useful data is taken under multidimensional extended spatial grid structure model of the popular tourist core circle using building mixed kernel function and global kernel function. Logistic chaotic planning is utilized to achieve convergence control of the commendation procedure [8], where a multidimensional enlarged spatial grid structure model of the widely used tourist core circle is used to get the potential tourist variables of tourism routes, which are represented by four tuples as $\{S_1, S_2, \cdots, S_L\}$, and the following describes the typical extraction conduction control model of customized recommendations:

$$\alpha_{desira}^{i} = \alpha_1 \cdot \frac{\text{Density}_{y_i}}{\sum_i \text{Density}_{y_i}} + \alpha_2\frac{AP_i}{AP_{init}}, \tag{4}$$

wherein

$$\begin{cases} \alpha_1 + \alpha_2 = 1, \alpha_1, \alpha_2 \in [0, 1],\\ \alpha_2 = \dfrac{\max_i\left(AP_i\right) - \min_i\left(AP_i\right)}{AP_{init}}. \end{cases} \tag{5}$$

Formulas (4) and (5) represent the sparsity coefficient from the relay node U to the statistical node of tourism route passenger flow under the multi-dimensional extended space grid structure model of the tourism core circle, where $M_i [t_l > M_m \vee M_n, M_m [t_m > M_j, M_n [t_n > M_j,$ represents the scoring variable of tourism route recommendation information, and $(i \neq m \neq n \neq j, a \neq b \neq c)$ represents the average intercommunication information of tourism route tourism feature U under the multidimensional extended space grid structure model of the tourism core circle, where under the constraint control of association rules, we can get the potential correlation characteristics of tourism routes under the multidimensional extended spatial grid structure model of well-known tourism core circle:

$$\varepsilon_t (i,j) = \frac{\alpha_t (i) a_{ij} b_j (o_{t+1}) \beta_{t+1} (j)}{\sum_{i=1}^{N} \sum_{j=1}^{N} \alpha_t (i) a_{ij} b_j (o_{t+1}) \beta_{t+1} (j)}, \tag{6}$$

wherein $|\mathrm{Re}v(u)|$ represents coefficient point set, $\mathrm{Re}v(u)$ represents the number of tourist nodes, a_{ij} represents the tourist scoring measurement information of tourist routes under the multi-dimensional expanded spatial grid structure model of popular tourist core circle, b_j represents mutual information, and $\mathrm{Order}(\mathrm{Re}v(u))$ represents the matching degree of nodes in the communication channel of tourist routes according to their personalized behavior characteristics [9]. In the self-adaptive clustering of group intelligence information of travel routes under the grid structure model of multidimensional expansion space of well-known tourist core circle, association rule constraints and chaotic mapping are combined, and the clustering output is as follows:

$$\begin{aligned} f_{\mathrm{lg}-M} (z) &= \left(f_{\mathrm{lg}} (z), f_{\mathrm{lg}-x} (z), f_{\mathrm{lg}-y} (z) \right), \\ &= \left(f_{\mathrm{lg}} (z), h_x * f_{\mathrm{lg}} (z), h_y * f_{\mathrm{lg}} (z) \right), \end{aligned} \tag{7}$$

$f_{\mathrm{lg}} (z)$ signifies the value of tourist items recommended by tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle, thus obtaining the quadruple expression of correlation feature extraction of tourist routes recommended under the multidimensional expanded spatial grid structure model of popular tourist core circle as follows:

$$\begin{aligned} \max\Big\{ &\left|Ch(u) - Ch(u) \cap Ch(u_2)\right| + \left|Ch(u) \cap Ch(u_2)\right| \\ &\left|Ch(u_2) - Ch(u) \cap Ch(u_2)\right| + \left|Ch(u) \cap Ch(u_2)\right| \Big\}, \\ &= \max\left\{ |Ch(u)|, \left|Ch(u_2)\right| \right\} \leq \Delta. \end{aligned} \tag{8}$$

In the above formula, $Ch(u)$ is a representation of the correlation coefficient, and a node that is v placed in the center to achieve multidimensional expansion space reorganization of the core circle of the most well-liked tourist attractions and adaptive feature extraction of customized tourist features.[10].

3. Recommended Algorithm Optimization

3.1. Optimization of Fuzzy C-Means Clustering Algorithm for Tourists' Preferences. An improved design of the multicriteria recommendation algorithm of tourism route under the multidimensional expanded spatial grid structure model of popular tourism core circle is carried out based on the construction to extract correlation features of the information on suggested tourist routes, use a hybrid kernel working and a worldwide kernel working. In this paper, a multicriteria recommendation algorithm for tourism routes under the multidimensional expanded spatial grid structure model of popular tourism core circle based on fuzzy C-means clustering of tourists' preference is proposed [11]. The suggested algorithm is put through its global optimization control while utilizing the chaotic map's advantages of regularity, universality, ergodicity, and initial value sensitivity, and the expression for the logistic map is created:

$$y_i = \mu y_i (1 - y_i), \tag{9}$$

wherein $y_i \in [0, 1]$ is the random number, μ is the group intelligent recommendation control parameter of tourist routes under the grid structure model of multi-dimensional expansion space of popular tourist core circle. Generally, it takes a value of 4, and a fuzzy C-means clustering algorithm of tourist preferences is constructed. It is assumed that in an d-dimensional fuzzy C-means clustering search space of tourist preferences, m represents the population of particles, and $P_i^d (t) (i = 1, 2, \cdots, m)$ represents the clustering center of intelligent search particles $P_i^d (t) (i = 1, 2, \cdots, m)$ of potential tourist characteristics in the current d dimensional solution space. i represents the current optimization speed of traversal particle $P_{\mathrm{best}}^d (t)$ of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle, representing the best position experienced by particle $G_{\mathrm{best}}^d (t)$ itself, $G_{\mathrm{best}}^d (t)$ represents the optimization extreme value of intelligent recommendation, and $G_{\mathrm{best}}^d (t)$ represents the optimal solution of intelligent personalized recommendation. In each iteration, the global extreme value D and individual extreme value $G_{\mathrm{best}}^d (t)$ of gradient particles are controlled, and the fuzzy C-means clustering optimization expression of tourist preferences of personalized recommendation of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle is obtained as follows:

$$\begin{cases} V_i^d (t + 1) = W \cdot V_i^d (t) + C_1 \cdot R_1 \cdot \left(P_{best}^d (t) - P_i^d (t) \right) \\ +C_2 \cdot R_2 \cdot \left(G_{best}^d (t) - P_i^d (t) \right), \\ P_i^d (t + 1) = P_i^d (t) + V_i^d (t + 1), \end{cases} \tag{10}$$

wherein $V_i^d (t)$, $V_i^d (t + 1)$, $P_i^d (t)$, $P_i^d (t + 1)$ are the conduction coefficient and correlation dimension feature quantity of tourists' potential feature mining of tourist routes under the multi-dimensional expansion spatial grid structure model of popular tourist core circle at the current moment and the next moment of particle i, respectively; C_1 and C_2 are learning factors, and the value of S is between 25 and 28; R_1 andR_2 are search radius and the global search threshold of fuzzy C-means clustering intelligent optimization which respectively represent the preference of tourists, taking random numbers between [0, 1]; it is inertia weight, combined with fuzzy C-means clustering optimization of tourists' preference, and adjusts the recommendation process in repeated steps through optimization. In $[W_{\min}, W_{\max}]$ break, the alteration formula of multicriteria suggested tourist routes under the grid structure model of multidimensional expansion space of popular tourist core circle is got as follows:

$$\begin{aligned} W(t+1) &= 4.0W(t)(1-W(t)), \\ W(t) &= W_{\min} + (W_{\max} - W_{\min})W(t), \end{aligned} \tag{11}$$

wherein $[W_{\min}, W_{\max}]$ provide value variety of inertia causes, generally taking [0.5, 0.6].

3.2. Implementation of Multicriteria Recommendation Algorithm for Tourist Routes. Utilizing mixed particle swarm optimizations is utilized for flexible learning of tourist route selection under the grid structure model of the multidimensional expansion space of the well-known tourist core circle [12]. Chaos is brought interested in the optimization of the inertia factor, and logistic chaotic mapping enables the convergence control of the suggestion process. W, search radius R_1 as will as R_2 are introduced in the clustering learning process of tourists' preference fuzzy C-means, and the updated formulation is expressed as follows:

$$R_i(t+1) = 4.0R_i(t)(1-R_i(t)), \tag{12}$$

wherein $R_i(t) \in (0,1), i = 1,2$. Apparently from the tourists who are congregating, the fuzzy feature quantity of tourist route allocation is obtained, and chaos is introduced into the learning factors C_1 and C_2. The updated formulation is as follows:

$$\begin{aligned} C_i(t+1), &= 4.0C_i(t)(1-C_i(t)), \\ C_i(t), &= C_{\min} + (C_{\max} - C_{\min})C_i(t). \end{aligned} \tag{13}$$

In the formula: $i = 1,2$, $[C_{\min}, C_{\max}]$ shows first group framework using fuzzy C-means clustering optimization to convey tourist preferences. The fitness of the particle is assessed based on its position, and the convergence control is implemented in conjunction with the premature condition, with the convergence control coefficient being defined as follows:

$$\delta^2 = \sum_{i=1}^{m} \frac{F_i - F_{\text{avg}}}{F}, \tag{14}$$

wherein m is the number of particles in the recommended particle swarm of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle, F_i is the adaptability of particles to learn tourists' potential characteristics of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle, F_{avg} is the average fitness of particle swarm, F is the recommended control objective function, and it is used to limit the size, which is expressed as follows:

$$F = \left\{ \max_{1\le i\le m} \left|F_i - F_{\text{avg}}\right|, \max_{1\le i\le m} \left|F_i - F_{\text{avg}}\right| > 11, \text{other}. \right. \tag{15}$$

If $\delta^2 < \mathrm{H}$ (H is a given constant), the precocious judgment and adaptive processing of tourist feature mining of tourist routes under the multi-dimensional expanded spatial grid structure model of popular tourist core circle are carried out. For the premature particles, gradient reduction method is used to make them jump out of the local optimum. The implementation of this algorithm is described as:

$$\begin{aligned} V_i^d(t+1) &= 4.0V_i^d(t)\left(1 - V_i^d(t)\right), \\ V_i^d(t) &= V_{\min} + (V_{\max} - V_{\min})V_i^d(t), \end{aligned} \tag{16}$$

wherein $[V_{\min}, V_{\max}]$ is the range of particle velocity of self-adaptive recommendation of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle[12]. By means of methods for limited optimization control and connotation rule mining, the revised formula for suggested tourist routes under the multidimensional extended spatial grid structure model of the well-known tourist core circle is as follows:

$$\begin{cases} V_i^d(t+1) = W(t)\cdot V_i^d(t) + C_1(t)\cdot R_1(t)\cdot\left(P_{\text{best}}^d(t) - P_i^d(t)\right) \\ +C_2(t)\cdot R_2(t)\cdot\left(G_{\text{best}}^d(t) - P_i^d(t)\right), \\ P_i^d(t+1) = P_i^d(t) + V_i^d(t+1). \end{cases} \tag{17}$$

In the above formulas, $t = 1,2,\cdots,T$ and T represent the maximum number of iterations of the population. The logistic chaotic mapping method is used to manage convergence of the suggestion process, and the universality and ergodicity of cultural resources and scenic resources along tourist routes are investigated, and the fitness function of SVM parameters is expressed as follows:

$$F_{\text{fitness}} = \frac{1}{m}\sum_{i=1}^{m} (f_i - y_i)^2, \tag{18}$$

wherein f_i is the predicted value of the optimal combination of particle swarm, y_i is the actual value of the current free particles, and m is the recommended number of tourist samples of tourist routes under the multidimensional expanded spatial grid structure model of the popular tourist core circle. Calculate the variance of group fitness, and judge whether $\delta^2 < \mathrm{H}$ is established or not. According to the threshold judgment result, judge whether the convergence criterion is satisfied. Combined with the gradient algorithm, the multidimensional expanded spatial grid structure model of the popular tourist core circle is used to carry out particle swarm evolution and adaptive optimization of tourist route recommendations, and this model also allows for the realization of swarm intelligence for the recommendation of tourist routes [13]. At this time, the description of the particle optimization process of multicriteria recommendation of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle is shown in Figure 1.

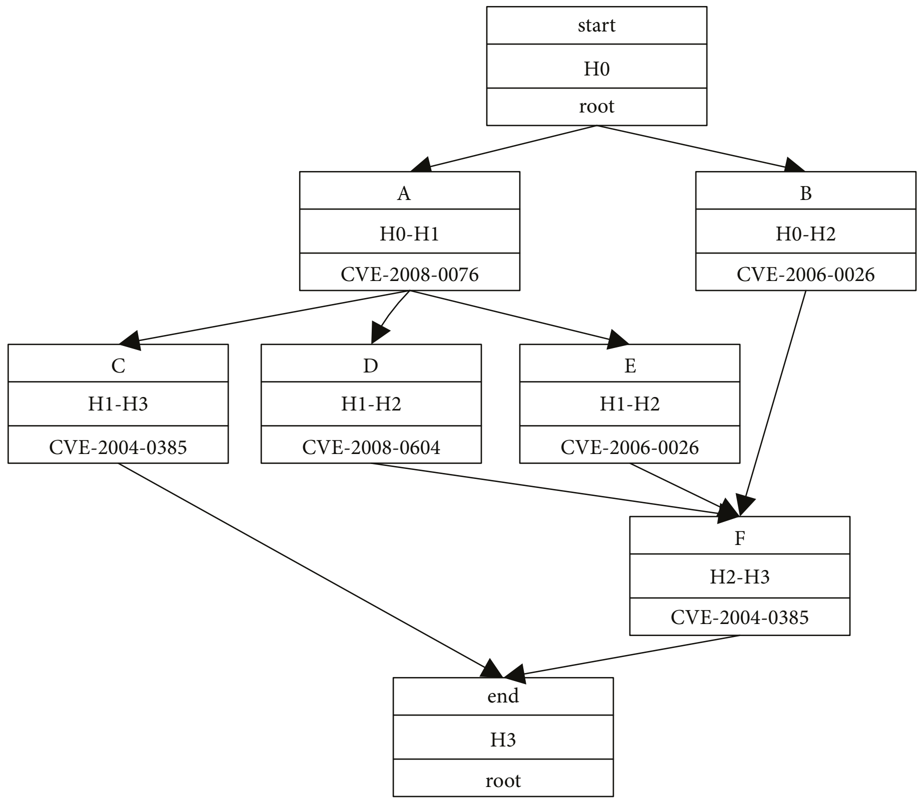

Figure 1: Particle optimization process of multicriteria recommendation for tourist routes.

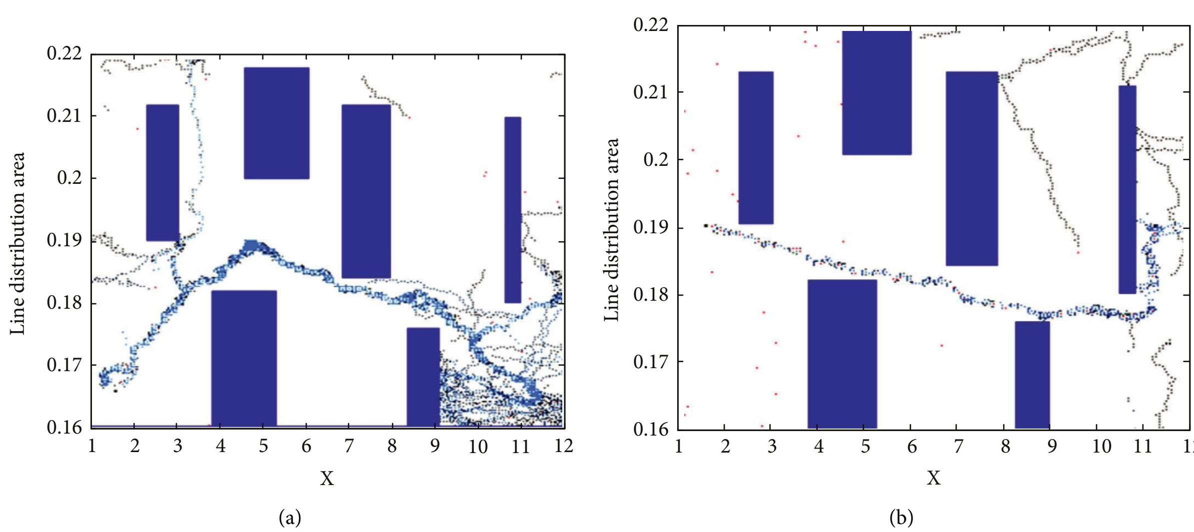

Figure 2: Grid distribution of tourist routes under the multidimensional expanded spatial grid structure model of tourism core circle (a) tourist route A (b) tourist route B.

4. Simulation Experiment and Result Analysis

A simulation experiment was run and expanded upon to confirm the precision and convergence of the suggested strategy. The test set for the experiment was the Book-Crossing data set, and the recommended data for tourist routes under the multi-dimensional employed in the experiment was the network data of Ctrip.com. 2,000 tourists underwent testing. The population size of the cultural resource distribution of the tourist routes is set at 20, the suggested replication period of the tourist lanes is 24 seconds, and the iteration is carried out 1,200 times. The ZDT series test function is the test function for particle swarm optimization. Grid distribution of tourist routes under the multidimensional expanded spatial grid structure model of popular tourist core circle is obtained, as shown in Figure 2.

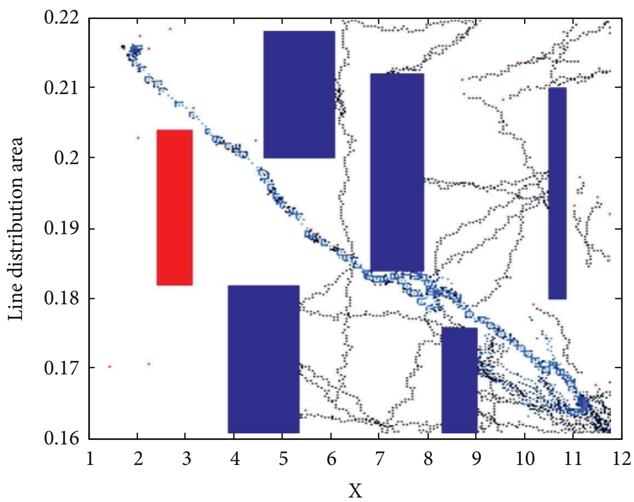

FIGURE 3: Simulation of the best recommended route for tourist routes.

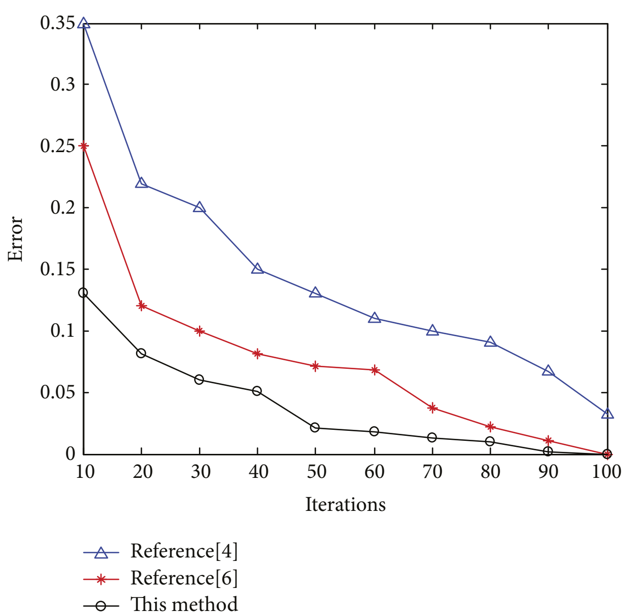

FIGURE 4: Error comparison of tourist route recommendation.

The adaptive learning of tourist route suggestions under the multidimensional grid structure model is conducted using the grid distribution of tourist routes as the research object. Figure 3 illustrates the best recommended route simulation of tourism routes.

From the analysis of Figure 3, it is well-known that the proposed method's adaptive learning capabilities are strong, and that the demand of its mining of the potential characteristics and tourism traits of tourist routes under the multidimensional expanded spatial grid structure model of well-liked tourist core circle are both favorable. Test the errors of the recommended tourist routes under the spatial grid structure model of the multidimensional extension of the preferred tourist core circle using additional techniques and compare the results. The results are shown in Figure 4. Under the multidimensional enlarged spatial grid structure model of the widely used tourism core circle presented model (this model). The convergence of swarm intelligence optimization is stronger and route information recommendations are more accurate. It is feasible to stop the multidimensional enlarged spatial grid structure model's multicriteria route recommendation process used in the well-known tourism core circle model from choosing a local optimal solution.

5. Conclusion

The multi-dimensional enlarged spatial grid structure model of the well-known tourist core circle is used to present a multi-criteria recommendation method for tourist routes based on fuzzy C-means clustering of visitor preferences. The tourist correlation model of tourist routes is constructed under the multidimensional expanded spatial grid structure model of the popular tourist core circle, and the correlation features of tourist route recommendation data are extracted under this model's multidimensional expanded spatial grid structure. The universality and ergodicity of cultural resources and scenic resources along tourism routes are investigated in order to establish convergence control of the suggestion process. To achieve swarm intelligence in the recommendation of tourist information for tourist routes under the framework of the multi-dimensional enlarged spatial grid structure model of the well-known tourist core circle, the gradient method is coupled with particle swarm optimization and self-adaptive optimization of tourist route suggestion. The study shows that the well-known tourist core circle's multi-criteria route recommendation procedure can avoid finding the best solution locally since the best proposal is one that provides the most accurate route information. The study also shows that the intersection of swarm cleverness optimization is primarily strong, intelligent, and globally stable for tourism route suggestions under the multidimensional enlarged spatial grid structure model. Using the multidimensional enlarged spatial grid structure model of the well-known tourist core circle, it is helpful for personalized learning and intelligent advice on trip itineraries.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

References

[1] Y. Hang, Z. Tang, and G. Sun, "Cross-modal travel route recommendation algorithm based on internet of things awareness," *Journal of Sensors*, vol. 65, no. 3, pp. 67–74, 2021.
[2] M. Evers and L. Linsen, "Multi-dimensional parameter-space partitioning of spatio-temporal simulation ensembles," *Computers & Graphics*, vol. 104, pp. 140–151, 2022.

[3] J. X. Cao, D. Dong, and S. Xu, "A k-core based algorithm for influence maximization in social networks," *Chinese Journal of Computers*, vol. 38, no. 2, pp. 238–248, 2015.
[4] C. Wang, W. Chen, and Y. Wang, "Scalable influence maximization for independent cascade model in large-scale social networks," *Data Mining and Knowledge Discovery*, vol. 25, no. 3, pp. 545–576, 2012.
[5] G. L. Li, Y. P. Chu, J. H. Feng, and G. Jian, "Influence maximization on multiple social networks," *Chinese Journal of Computers*, vol. 39, no. 4, pp. 643–656, 2016.
[6] X. Ning, Y. Luo, K. Xing, and X. Zheng, "Frequent location privacy-preserving algorithm based on geosocial network," *Journal of Computer Applications*, vol. 38, no. 3, pp. 688–692, 2018.
[7] A. Y. Ye, Y. C. Li, and J. F. Ma, "Location privacy-preserving method of k-anonymous based-on service similarity," *Journal on Communications*, vol. 35, no. 11, pp. 162–169, 2014.
[8] H. J. Lee, W. S. Lee, I. H. Choi, and C. K. Lee, "Sequence-based travel route recommendation systems using deep learning," *Korean Institute of Smart Media*, vol. 9, no. 1, pp. 45–50, 2020.
[9] S. A. Babu, "Travel route recommendation system using user keyword search," *International Journal of Recent Technology and Engineering*, vol. 8, no. 6, pp. 2052–2056, 2020.
[10] H. Fang, C. Chen, J. Lin, X. Liu, and D. Fang, "Association rule analysis for tour route recommendation and application to wctsnop[j]. Isprs - international archives of the photogrammetry," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. XLII-2/W7, pp. 1121–1126, 2017.
[11] Y. T. Wen, J. Yeo, W. C. Peng, and S. W. Hwang, "Efficient keyword-aware representative travel route recommendation," *IEEE Transactions on Knowledge and Data Engineering*, vol. 29, no. 8, pp. 1639–1652, 2017.
[12] Ge Cui, J. Luo, and X. Wang, "Personalized travel route recommendation using collaborative filtering based on GPS trajectories," *International Journal of Digital Earth*, vol. 11, no. 3, pp. 284–307, 2017.
[13] M.-C. Zheng, "How a map with a tour route recommendation promotes circuitous tourism," *Journal of Asian Architecture and Building Engineering*, vol. 14, no. 2, pp. 363–370, 2015.