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Analysis of the Influence of Scenic Spot Clustering and Group Emotion on Tourism Route Selection Based on Data Mining

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ABSTRACT

The rapid expansion of tourism across the world necessitates constant innovation and development in the services offered to visitors in order to assure their comfort and happiness while on the road. Travelers' experiences may be greatly enhanced by providing them with basic and essential conveniences such as optimal route identification and suggestion technology. In this paper, we use data mining to investigate the effect of scenic site clustering and group emotion on tourist route choosing. It is common for traditional route selection algorithms to just examine the impact of picturesque locations on route design. Many people choose the Chimp optimization algorithm (ChOA) because of its straightforward idea, simple implementation, and high level of resilience. With the goal of solving practical challenges in mind, this study uses real-world geographic data to build a discrete ChOA for the tourism route planning problem, which may be applied in practice. Simulation experiments are done, and outcomes data are studied and assessed. The assessment findings show that the ChOA is suitable for mass tourist data mining. The smart machine's final best tour routes are directly tied to the requirements, interests, and habits of visitors and are completely connected with geospatial services to ensure accuracy. The ChOA algorithm serves as a good example of how data mining may be used in the field of mass tourism.

Keywords: Chimp optimization algorithm, scenic spot, clustering, group emotion, tourism route selection.

1. Introduction

With the arrival of the 21st century, people can no longer satisfy just for the search for food and

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clothing, more seeking psychological enjoyment, so travel has become an indispensable part of life [1-3]. Most people spend their vacations by traveling [4]. According to the research institute, the number of travelers in China reached 3.0 billion in 2012, a year-on-year increase of 13.6%. This fully demonstrates the rapid growth of the number of travelers [5-6]. Because more and more people choose to go out for traveling, it is especially important to choose a suitable as well as suitable travel route [7-8].

Tourism route is a comprehensive consideration of tourism organizers in a certain geographical scope of the spatial distribution of tourism resources and traffic conditions, tourists' travel motives and preferences, travel time and space costs and other factors affecting the different scenic spots and attractions for tourism timing and itinerary of the spatial optimization and route design, in order to attract and satisfy the most travelers' travel needs and tourism experience [9-12]. Tourism routes reasonably link the subject and object of tourism activities through transportation lines, so that tourists can get the maximum tour effect in a short period of time. Tourism routes have typical spatial attributes, which are the linear organization of socio-economic activities in geographic space [13-16].

Tourist route is the movement trajectory of tourists in the process of traveling. However, from different perspectives, there are different understandings of tourism routes [17-18]. From the perspective of planning and management of tourist attractions, tourist route refers to the tourist planning or management department for the convenience of tourists to visit the scenic spots in the tourist destination, attractions in the planning and design of the tour route [19-21]. From the point of view of tourism products, tourism line is a tourism product marketed by tourism operators or tourism management organizations to tourists or potential tourists, it is not only the movement of tourists in the entire tourism process, more importantly, contains the tourists in the entire tourism activities in the schedule and includes all the services and prices of food, accommodation, transportation, travel, shopping, entertainment, etc. [22-25].

The rest of the paper is organized as follows: Section 2 presents the multi-objective discrete chimp optimization algorithm, including the presentation of the ChOA and binary ChOA. Section 3 presents the design and implementation model. Section 4 presents the simulation results and discussion. Finally, section 5 presents the conclusion and future research directions.

2. Multi-objective discrete chimp optimization algorithm

2.1. Presentation of the ChOA

Meta-heuristic algorithms like ChOA are expected to emerge in 2020. The ChOA is based on the social structure and sexual desire of chimps. ChOA employs an approach known as "prey hunting" to solve the optimization issue. There are four primary phases to hunting: driving, blocking, chasing, and attacking. The initial population of chimpanzees in ChOA is chosen at random. Afterward, the chimpanzees are sorted into four equal groups and then unleashed into the field. These groups are named assailants, obstacles, runners, and movers. The prey is being pushed and pursued using the Eqs. (1) through (5).

$$d = \left| c.X_{prey}(t) - m.X_{chimp}(t) \right| \tag{1}$$

$$X_{chimp}(t+1) = X_{prey}(t) - a.d \tag{2}$$

$$a = 2.f.r_1 - f \tag{3}$$

$$c = 2.r_2 \tag{4}$$

$$m = Chaotic\_value \tag{5}$$

The X_{prey}, X_{chimp} denotes the location of the prey and the position of the chimp, respectively; variables a, c, and m represent the coefficient variables, whilst f represents the dynamic vector with a range of (0,2.5), $r_1\, and\, r_2$ signify random vectors.

Chimpanzees hunt for prey by employing a three-part strategy: the driver, the blocker, and the chaser. This is the point at which the attackers assume control and begin hunting. For their own purposes, predatory chimps rely on victims to pinpoint their exact location, while defender chimps keep tabs on the pursuers' and drivers' movements. These concepts are laid out in Eqs. (6) to (8).

$$\begin{gathered} d_{Chaser} = \left|c_3.X_C - m_3.X\right|, d_{Driver} = \left|c_4.X_D - m_4.X\right| \\ d_{Attacher} = \left|c_1.X_A - m_1.X\right|, d_{Barrier} = \left|c_2.X_B - m_2.X\right| \end{gathered} \tag{6}$$

$$\begin{gathered} X_1 = X_{Attacher} - a_1\left(d_A\right), X_2 = X_{Barrier} - a_2\left(d_B\right) \\ X_3 = X_{Chaser} - a_3\left(d_C\right), X_4 = X_{Driver} - a_4\left(d_D\right) \end{gathered} \tag{7}$$

$$X\left(t+1\right) = \frac{X_1 + X_2 + X_3 + X_4}{4} \tag{8}$$

Setting criteria like a, which indicates if the chimps and prey are splitting or not, is an essential element of the exploration process. The chimps and their prey will also be converging if a variable is adjusted to +1 or -1. This is crucial to remember. To further help in the algorithm's exploration, parameter c is included. For all chimpanzees, the ultimate purpose of prey hunting is to achieve social privileges. In a chaotic map, social behavior may be modeled using Eq. (9).

$$X_{chimp}\left(t+1\right) = \begin{cases} X_{prey}\left(t\right) - a.d & if\ \mu < 0.5 \\ Chaotic\_value & if\ \mu \geq 0.5 \end{cases} \tag{9}$$

Where, μ denotes the random number in the range of (0,1].

2.2. Binary ChOA (Bin-ChOA)

2.2.1. Binary ChOA-1 (Bin-ChOA-1). Chimpanzees are able to change their position at any moment in time and in either direction, thanks to continuous ChOA. There are just two possible values for ChOA in discrete problems: zero and one. The search space of a binary metaheuristic method is a hypercube. It is only possible to traverse this hypercube by utilizing meta-heuristic optimization algorithm drivers to transform zero to one and one into zero. When constructing the Bin-ChOA, key concepts of the method for changing positions had to be changed.

The chimpanzees use a four-vector updating formula. Because the binary version of ChOA only has two possible values (0 and 1), the position cannot be updated using Eq. (8). One way or the other, the chimpanzees' positions must be changed from zero to one and then back to zero again. To put it another way, Eq. (8) needs to be updated to reflect the new position. Consequently, a function that converts the continuous search area into the binary space is required. The probability of transferring the position vector elements from 0 to 1 is provided by the transfer function. To get around in binary space, chimps must rely on transfer functions to get around. Many algorithms employ transfer functions, which allow the operator concepts to be transferred from a continuous to a binary space.

For the Bin-ChOA, Eq. (10) is used as the starting point for the initial position update. The chimps are not constrained to accept values of 0 or 1 when using transfer functions like T(x) in this way. Chimps are urged to stay put while their values are minimal and to go to their opponents when the values are high, in other words. In this case, two well-known transfer functions are applied (Bin-ChOA11 and Bin-ChOA12).

$$X_d^{t+1} = \begin{cases} (X_d^t)^{-1} if R < T\left(\dfrac{X_1 + X_2 + X_3 + X_4}{4}\right) \\ X_d^t otherwise \end{cases} \tag{10}$$

$$T_1(x) = \left|\frac{2}{\pi} arc\tan(\frac{\pi}{2}x)\right|(\text{Bin} - \text{ChOA11}) \tag{11}$$

$$T_2(x) = |\tanh(x)|(\text{Bin} - \text{ChOA12}) \tag{12}$$

2.2.2. Binary ChOA-2 (Bin-ChOA2). Position updating in the Bin-ChOA2 variant is based on Eq. (13), a sigmoid function-based equation. Note that the chance of altering position vector values grows as the gradient of the transfer function increases. As a result, two distinct slopes (corresponding to two distinct transfer functions: Bin-ChOA21 and Bin-ChOA22) are used in Eqs. (14) and (15).

$$X_d^{t+1} = \begin{cases} 1 & ifsig\left(\dfrac{X_1 + X_2 + X_3 + X_4}{4}\right) \geq R \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

$$Sig_1(x) = \frac{1}{1 + e^{-10(x-0.4)}} \ (\text{Bin} - \text{ChOA21}) \tag{14}$$

$$Sig_2(x) = \frac{1}{1 + e^{-5(x-0.4)}} \ (\text{Bin} - \text{ChOA22}) \tag{15}$$

Where, R denotes a random number between 0 and 1, X_d^{t+1} is the updated binary position, as shown in Figure 1, $Sig_1(x)$ and $Sig_2(x)$ are the S-shaped transfer functions.

2.2.3. Binary ChOA-3 (Bin-ChOA3). Bin-ChOA3's principal position update formulation is based on the equation Eq. (16). The values of X_1, X_2, X_3, X_4 may be calculated using four equations. There are two ways to define a binary mixture:

$$X_i^{t+1} = Binary\ mixture(X_1, X_2, X_3, X_4) \tag{16}$$

The binary mixture is used in this scenario. According to Eq. (16), the binary Binary mixture (X_1, X_2, X_3, X_4) is an acceptable mixture. Chimpanzees' movements toward the attacker, barrier, chaser, and driver are all represented by the following equations:

$$X_1^d = \begin{cases} 1 & if\left(X_\text{A}^d + B_\text{A}^d\right) \geq 1 \\ 0 & \text{ELSE} \end{cases} \tag{17}$$

$$B_\text{A}^d = \begin{cases} 1 & ifS_\text{A}^d \geq R \\ 0 & \text{ELSE} \end{cases} \tag{18}$$

$$S_\text{A}^d = \frac{1}{1 + e^{-10\left(a_1^d d_\text{A}^d - 0.3\right)}} \tag{19}$$

Where, X_A^d denotes the d dimension best chimp.

$$X_2^d = \begin{cases} 1 & if\left(X_\text{B}^d + B_\text{B}^d\right) \geq 1 \\ 0 & \text{ELSE} \end{cases} \tag{20}$$

$$B_{\mathrm{B}}^{d}=\begin{cases}1 & if S_{\mathrm{B}}^{d}\geq R\\ 0 & \mathrm{ELSE}\end{cases} \tag{21}$$

$$S_{\mathrm{B}}^{d}=\frac{1}{1+e^{-10\left(a_{2}^{d}d_{\mathrm{B}}^{d}-0.3\right)}} \tag{22}$$

X_{B}^{d} is the d dimension second-best chimp.

$$X_{3}^{d}=\begin{cases}1 & if\left(X_{\mathrm{C}}^{d}+B_{\mathrm{C}}^{d}\right)\geq 1\\ 0 & \mathrm{ELSE}\end{cases} \tag{23}$$

$$B_{\mathrm{C}}^{d}=\begin{cases}1 & if S_{\mathrm{C}}^{d}\geq R\\ 0 & \mathrm{ELSE}\end{cases} \tag{24}$$

$$S_{\mathrm{C}}^{d}=\frac{1}{1+e^{-10\left(a_{3}^{d}d_{\mathrm{C}}^{d}-0.3\right)}} \tag{25}$$

X_{Chaser}^{d} denotes the d dimension third-best chimp.

$$X_{4}^{d}=\begin{cases}1 & if\left(X_{\mathrm{D}}^{d}+B_{\mathrm{D}}^{d}\right)\geq 1\\ 0 & \mathrm{e}\\ ELSE & \end{cases} \tag{26}$$

$$B_{\mathrm{D}}^{d}=\begin{cases}1 & if S_{\mathrm{D}}^{d}\geq R\\ 0 & \mathrm{ELSE}\end{cases} \tag{27}$$

$$S_{\mathrm{Driver}}^{d}=\frac{1}{1+e^{-10\left(a_{3}^{d}d_{\mathrm{D}}^{d}-0.3\right)}} \tag{28}$$

X_{D}^{d} is the d dimension fourth-best chimp.

$$Binary\ mixture\left(a_{d},b_{d},c_{d},d_{d}\right)=\begin{cases}a_{d} & if R<0.25\\ b_{d} & 0.25\leq R<0.5\\ c_{d} & 0.5\leq R<0.75\\ d_{d} & ELSE\end{cases} \tag{29}$$

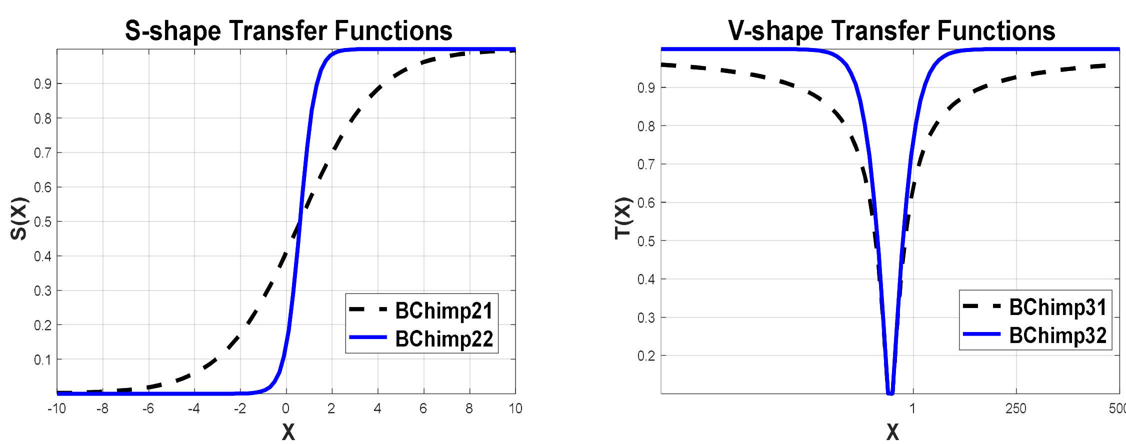

Fig. 1. S-shape vs. V-shape transfer functions

Changes to the transfer function and updating the location distinguish continuous and discrete ChOA. The transfer function technique is used to convert the continuous to binary space. Chimp positions may be updated from 0 to 1 using the binary search space's position update technique.

3. Model Implementation

Experiments have shown that this way of tackling specific data issues is feasible and effective and gives some suggestions for multiple processors of problems rather than blindly improving using concurrent utilities like most existing continuous models. The device's performance is blind to the real issue at hand. Some new concepts have been offered to enhance the metaheuristic algorithm; however, in the end, the path issues answered by these techniques are rarely evaluated with actual data, and most of them rely on them, even though they have been created in the past. In terms of the facts, it appears that the conditions necessary to fix the issues have been satisfied to an extent. In the real world, these better metaheuristic algorithms are powerless since their initial focus was on ChOA algorithms than on genuine specific issues. In contrast to the design thinking described in this article, which moves from issue to solution and then back to the problem, theirs is a process that begins with an algorithm and ends with a problem. Additionally, this article's route problem was solved by employing a binarized approach. Binary tools can be used for certain difficulties. Parallel processing has made great strides in recent years. Clusters, high-performance computing, and hybrid parallel models have all emerged. Parallel environments and models, on the other hand, are all about the computer. We need to know what is going on. Boost the speed of PCs. Some major organizations rely on mathematical test functions like Jacobi iteration or hardware components like chips to verify these models experimentally. While 8 or 16 multicore clusters are commonly used for large projects, four nodes and two nodes' multicore computers are typically used for testing purposes. A binary model for the real problem addressed in this work does not exist, no matter what approach is used to do it. ChOA algorithm and actual data are used to solve the TRS issue in this paper's application system model, which includes a parameter setup area and a problem-solving section. Binarization is used to increase the computer's performance. This enhances both the accuracy of solution findings and the rate at which issues are solved. Figure 2 shows the actual and predicted values.

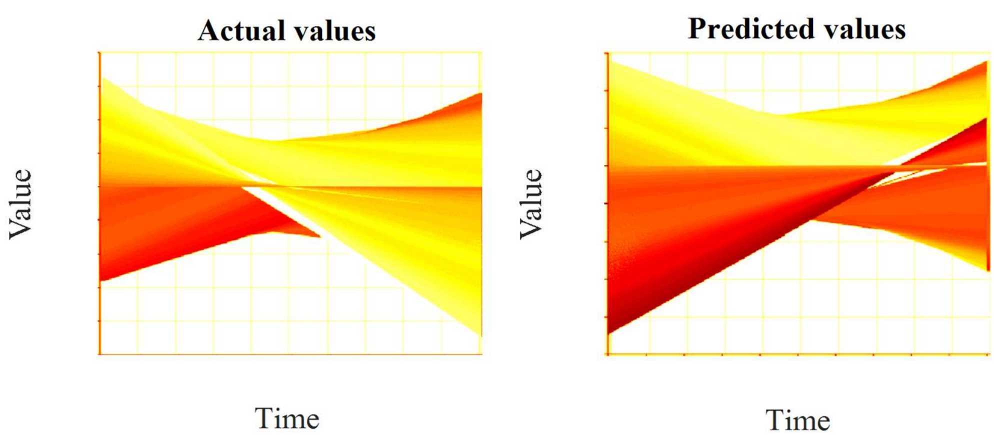

Fig. 2. The actual and predicted values

There are three key elements to the system, including a data area, a parameter area, and a TRS problem area, in order to effectively reflect the solution outcomes of the issue in the system and not interfere with one another. You may find information about tourist sites, road networks, and buildings in the area's three map layers. Using the map-operating software, the data is imported into the application system. Following data loading, basic actions such as zooming in and out, moving, and reloading may be conducted on the system using the map-operating software. The ChOA algorithm's initialization parameters, such as the number of chimps, the number of iterations, and the fitness value, are included in the parameter area. All the parameters that the problematic program needs to be initialized are included inside these settings. The parameter area can provide settings to the program based on the application's own data circumstances and demands. In Figure 3, the assessed data (i.e., Spot Clustering and Group Emotion) is shown in comparison.

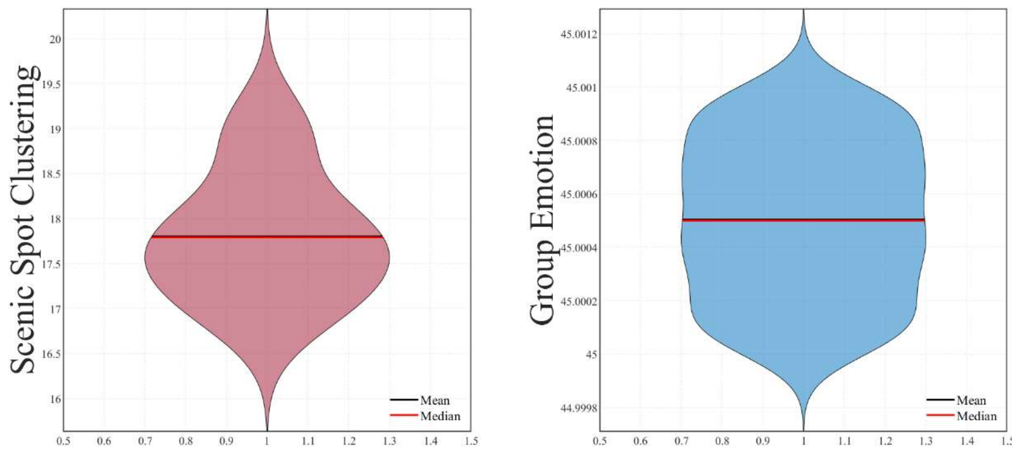

Fig. 3. The assessed data (i.e., Spot Clustering and Group Emotion)

In the system, "ChOA-1" represents the solution, while "ChOA" represents the method based on self-balancing. It indicates that "Bin-ChOA-1," "Bin-ChOA-2," and "Bin-ChOA-3" represent the self-balancing ChOA technique of binary decoding, which employs a progressive technique to reflect the algorithm's solving speed and reliability in line with people's perception of things.

To make the TRS problem solution result more visible and not be affected by the urban transportation infrastructure data, the route trajectory and route length will be displayed in the text box. The entire flow chart of the TRS model is illustrated in Figure 4 according to the stated integrative framework of the ChOA technique in the TRS problem.

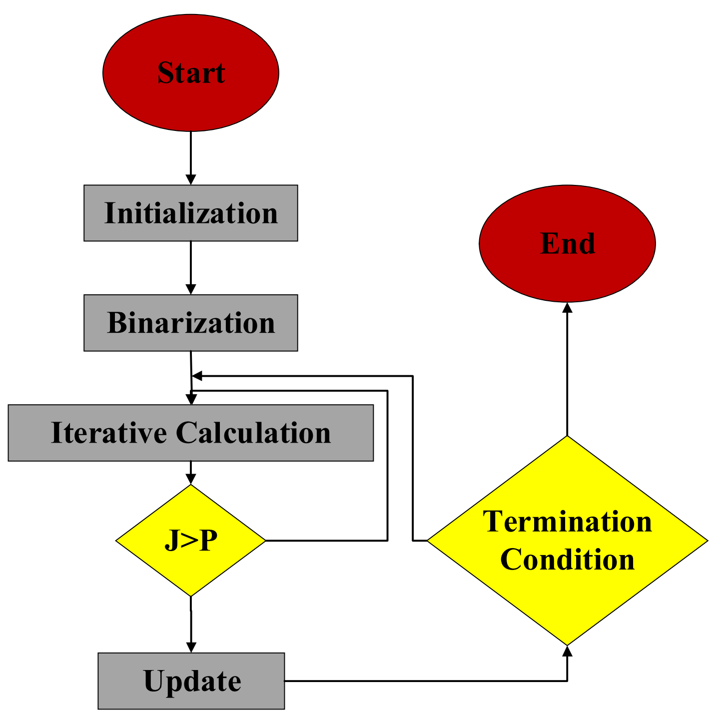

Fig. 4. The framework of the ChOA technique in the TRS problem

The primary challenge in the above model flow diagram is to regularize the data based on the specific map data and build an approach that can overcome the issue. For this TRS situation, the ChOA may be assured by calculating distances between tourist sites using methods based on geographic coordinates. The ChOA can find an optimal or better path, depending on the number of different chimpanzees and the number of repetitions. Additionally, the ChOA's binarization will be a significant step forward in the binary model application. TRS problem solving will be performed by each method in the architecture and outputted to a system interface based on parameter values.

All of the above-mentioned regions follow the same stages, regardless of which area is part of the system: You must first load location information and then change the display map data before entering any parameter values or using ChOA to help you fix the problem.

4. Experimental result and discussion

For conducting the experiment, the initial values and primary parameters of Bin-ChOA-1, Bin-ChOA-2, and Bin-ChOA-3 are summarized in Table 1. Using ArcGIS Engine, this article creates a desktop application that employs the Viterbi algorithm to create a travel route planning system that lets users specify their starting place, number of days, and type of trip and then automatically calculates which route is best for their needs.

Table 1. initial values and primary parameters

Algorithm	Parameter
Bin-ChOA-1	f
Bin-ChOA-2	r1, r2
Bin-ChOA-3	m

The Route to Take. The data must be handled after the parameters have been calculated. In ArcMap, first import all of the data and apply data points to each scenic spot and group emotion, which includes the Internet's data on user assessment and consumption levels. In this paper, the maximum longitude is 125.31 degrees; its minimal value is 125.10 degrees; its max latitude is 41.57 degrees; its minimal latitude is 41 degrees, and its NR-19 value is derived from the data shown above. 006, NC-20.001. Next, in ArcMap, use the Fishnet function and enter the above information to create a 25 25 grid. It's time to create the Part Fishnet Scenic and Emotion layer by overlaying the produced grid with tourist attractions. Currently, the attribute database of the new layer has the grid positions, grades, titles, and user evaluations for scenic areas and feelings. Consumption levels are inherent in all knowledge.

The author of this piece makes four different assumptions. Table 2 shows that each scenario has a different set of circumstances based on the demands of the tourists. In the first experiment, travelers began their journey at "Beijing University." The "Beijing Provincial Museum," which is next on the list of "Beijing University" attractions, offers free admission and a wide range of exhibits. This is one of Beijing's most cost-effective and high-value tourist attractions. The distance from "Beijing University" is around 3 kilometers, and it's not too far. " Hotel Hilton (Beijing Branch)" gets a high rating on travel websites like "C-trip" and is being sought after. The hotel is in a great position, just a short walk from the "Beijing Provincial Museum," and is reasonably priced. There are two kilometers to go until the intended route satisfies the needs of the users. Figures 5 to 14 depict the algorithm's convergence diagram for various population sizes.

Table 2. The details of the experiments

Experiment	Initial Point	Time (Day)	Type
No. 1	Beijing University	One	Economic
No. 2	Beijing University	One	Economic
No. 3	Beijing Provincial Museum	Two	Economic
No. 4	Beijing University	One	Economic

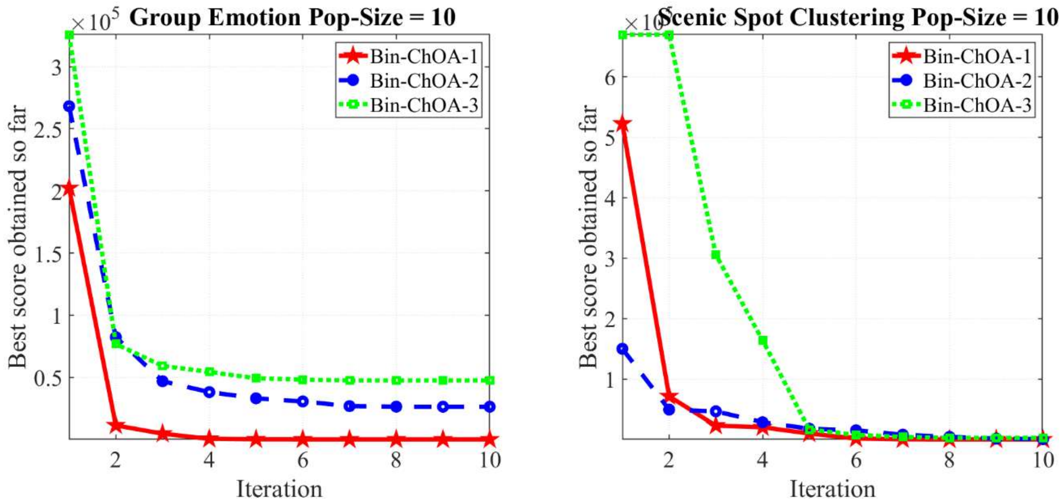

Fig. 5. The algorithms' convergence diagram for population size = 10

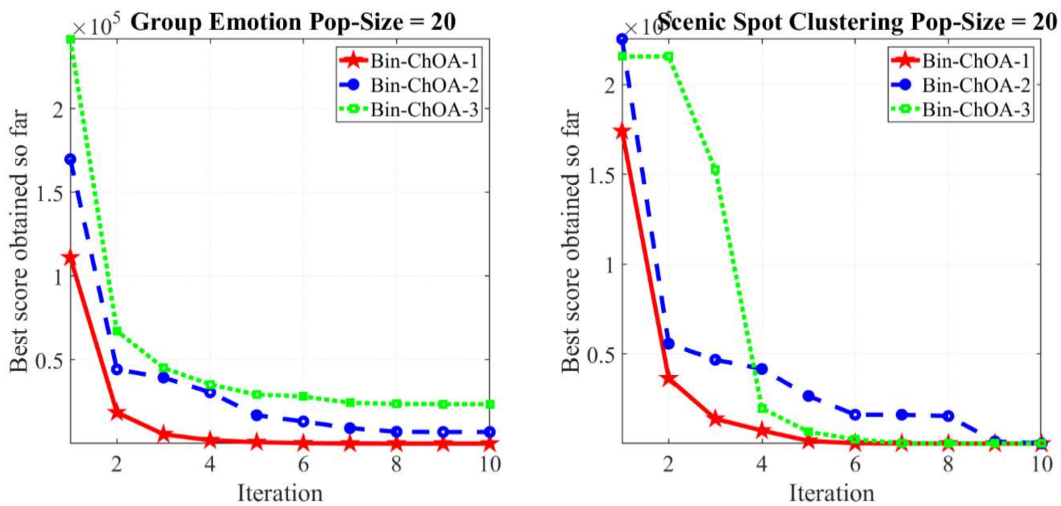

Fig. 6. The algorithms' convergence diagram for population size = 20

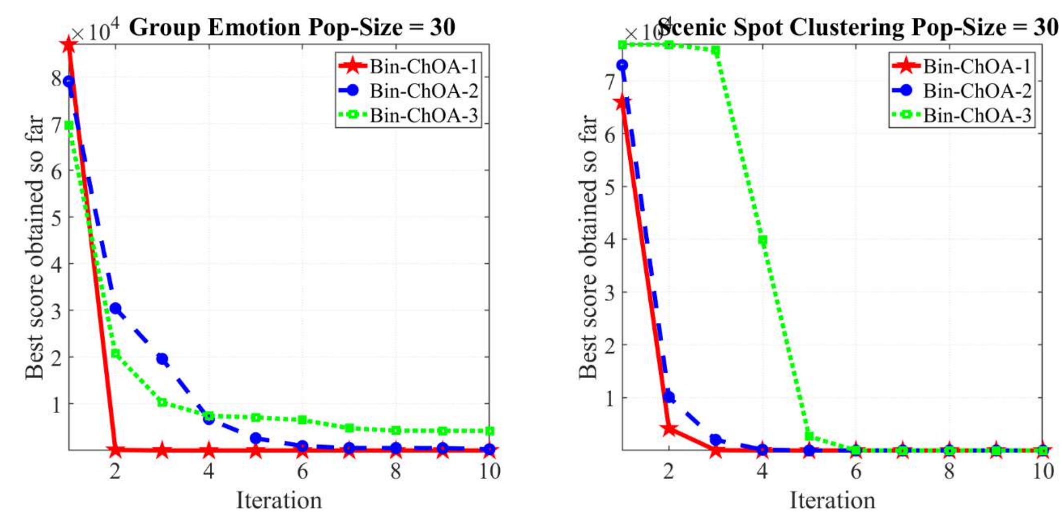

Fig. 7. The algorithms' convergence diagram for population size = 30

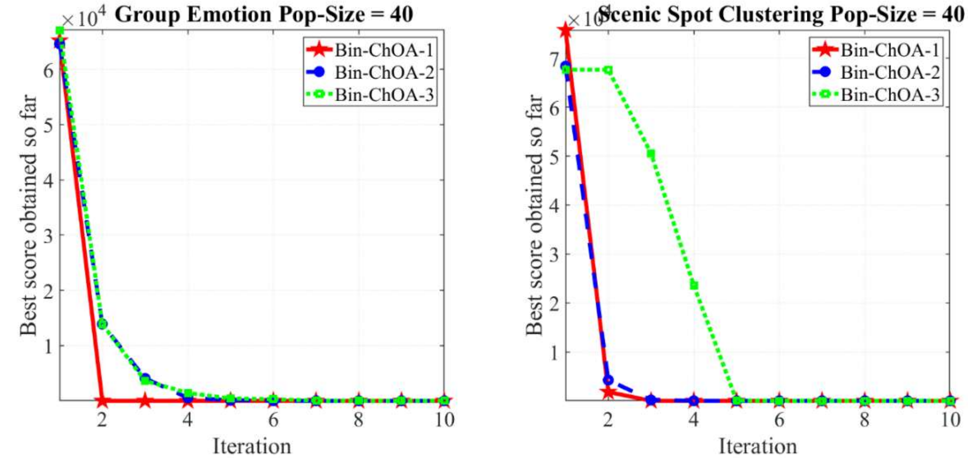

Fig. 8. The algorithms' convergence diagram for population size = 40

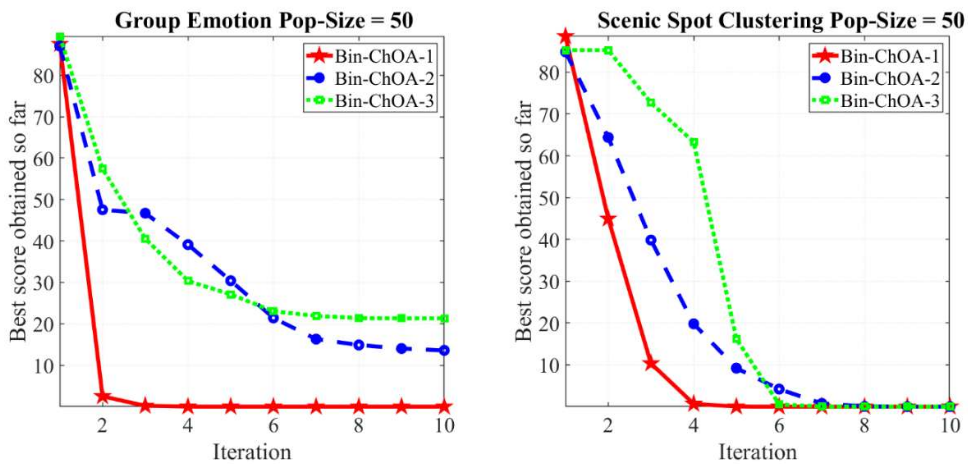

Fig. 9. The algorithms' convergence diagram for population size = 50

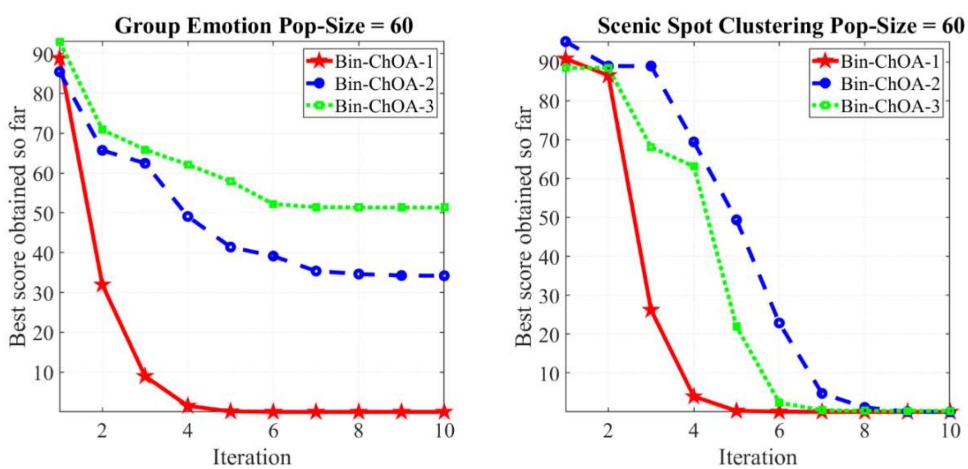

Fig. 10. The algorithms' convergence diagram for population size = 60

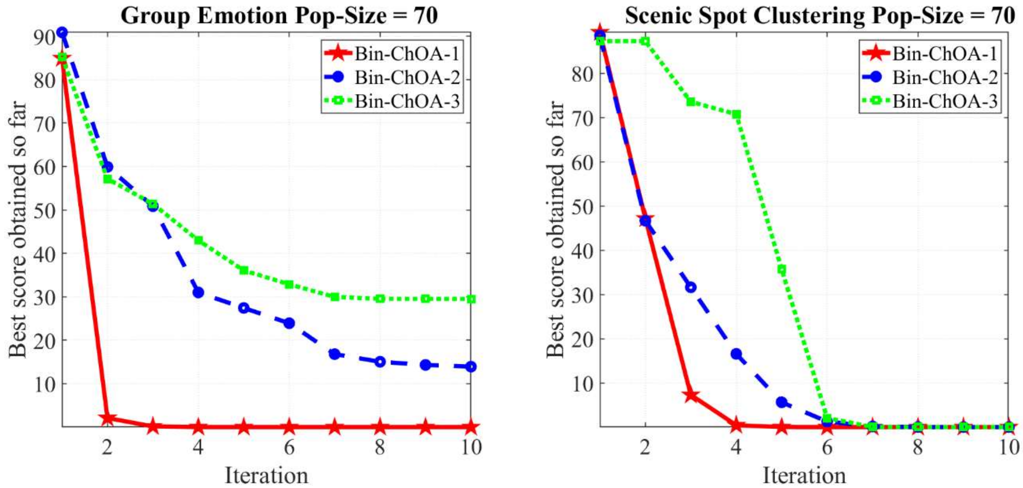

Fig. 11. The algorithms' convergence diagram for population size = 70

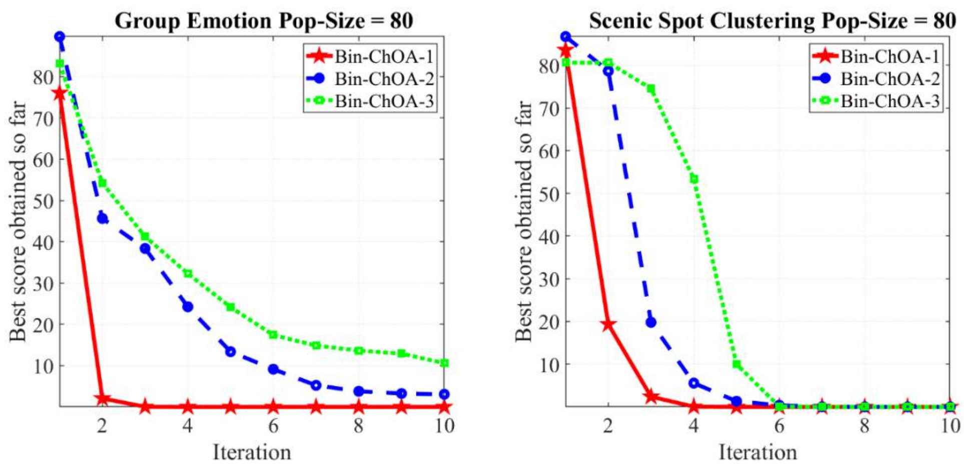

Fig. 12. The algorithms' convergence diagram for population size = 80

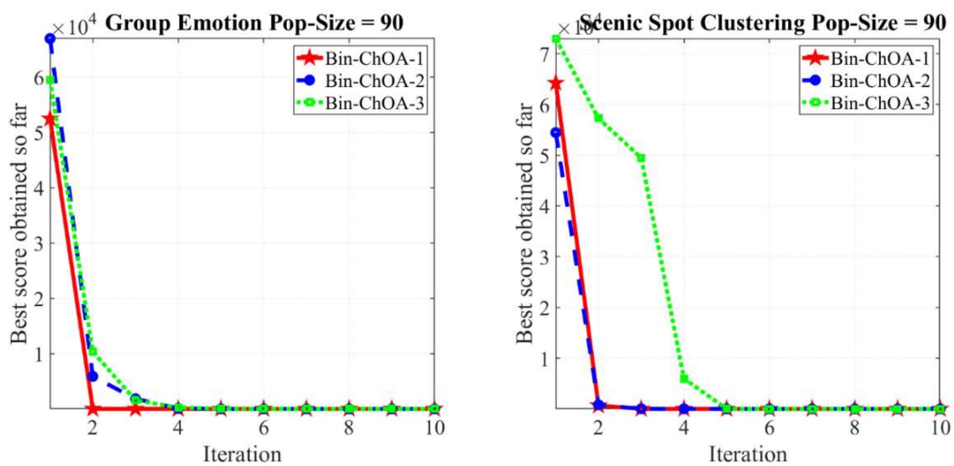

Fig. 13. The algorithms' convergence diagram for population size = 90

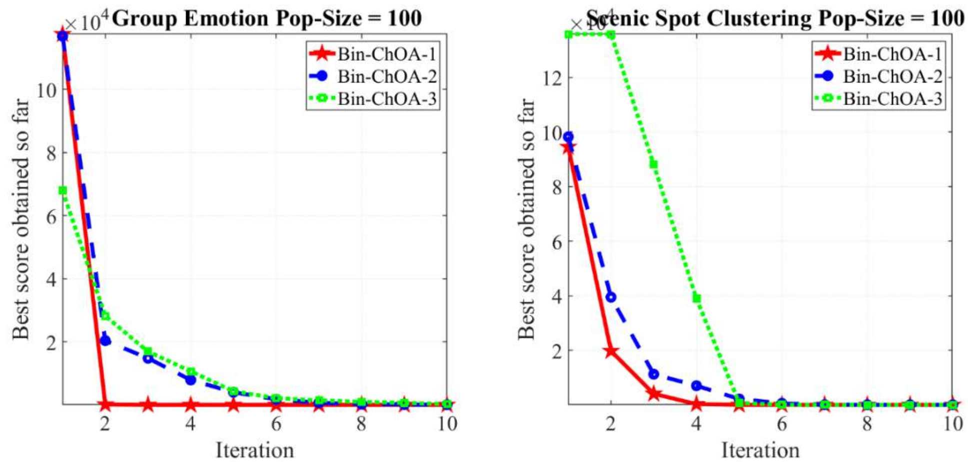

Fig. 14. The algorithms' convergence diagram for population size = 100

Experiment 1 is compared to Experiment 2, Experiment 3, and Experiment 4, which are all separate investigations. "Liu Zhang Street" was the next scenic place found in Experiment 2 when the trip type was just modified. As a retail and entertainment destination, it has been flanked by three major commercial areas. The average amount of food consumed per person is rather high. Four kilometers away from "Liu Zhang Street" in Beijing, a five-star Beijing hotel has been found. With a total distance of 1.9 kilometers, the final design meets the needs of tourists looking for a relaxing vacation. On the first day of Experiment 3, the trip route of Experiment 1 and Experiment 3 was discovered to be identical. Using the Viterbi method, it can be shown that its features change from a local optimal to an overall ideal; Experiment 3 of "Amusement Park." Many attractions are within a 12-kilometer radius of the place of interest, but the only ones that are reasonably accessible are "Liu Zhang Street" and "Beijing Jangle Road." There is a stronger influence on the outcome of the planning process when these two attractions are present. Despite the fact that "Beijing Jangle Road" is closer to the beginning place, consumption levels lead to the conclusion that "Liu Zhang Street" is superior. State transition probability and observation state probability are intertwined. Only the beginning point in Experiment 4 was modified, but the calculation results show no significant difference from Experiment 1 based on the findings.

These studies show how dynamic planning methods like the Viterbi algorithm leverage the dynamic distance between visitors and beautiful locations and hotels as well as their own travel requirements to build a travel routing protocol on the Viterbi algorithm. The correlation between location and transition probability can be better expressed by the aforementioned Gaussian function; the selection of vacation style allows visitors to choose from a variety of options. Figures 15 to 17 depict the best route obtained by Bin-ChOA-1, Bin-ChOA-2, and Bin-ChOA-3, respectively.

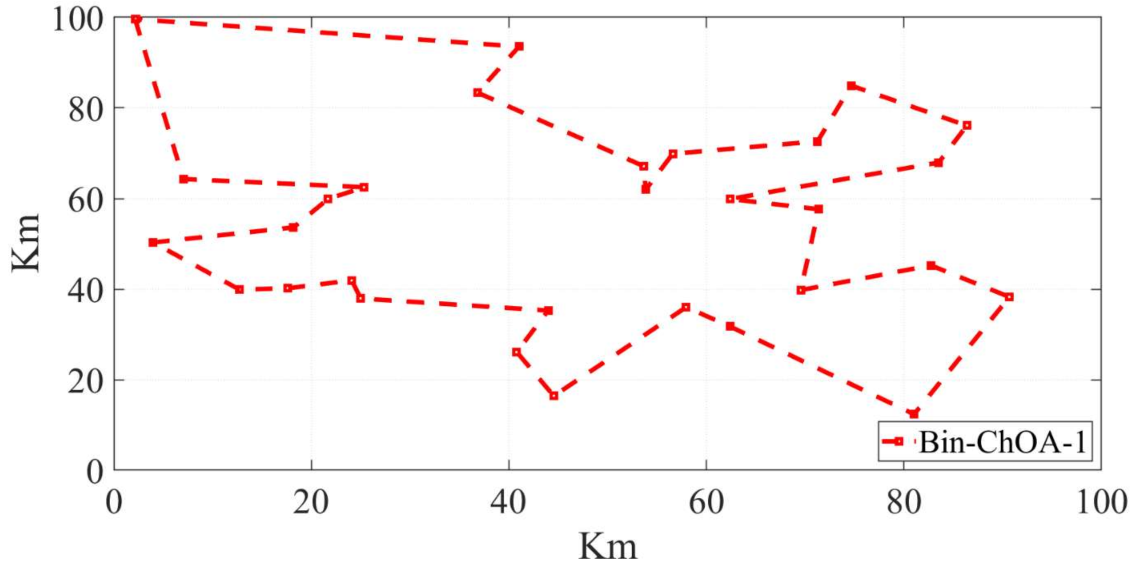

Fig. 15. The best route obtained by Bin-ChOA-1

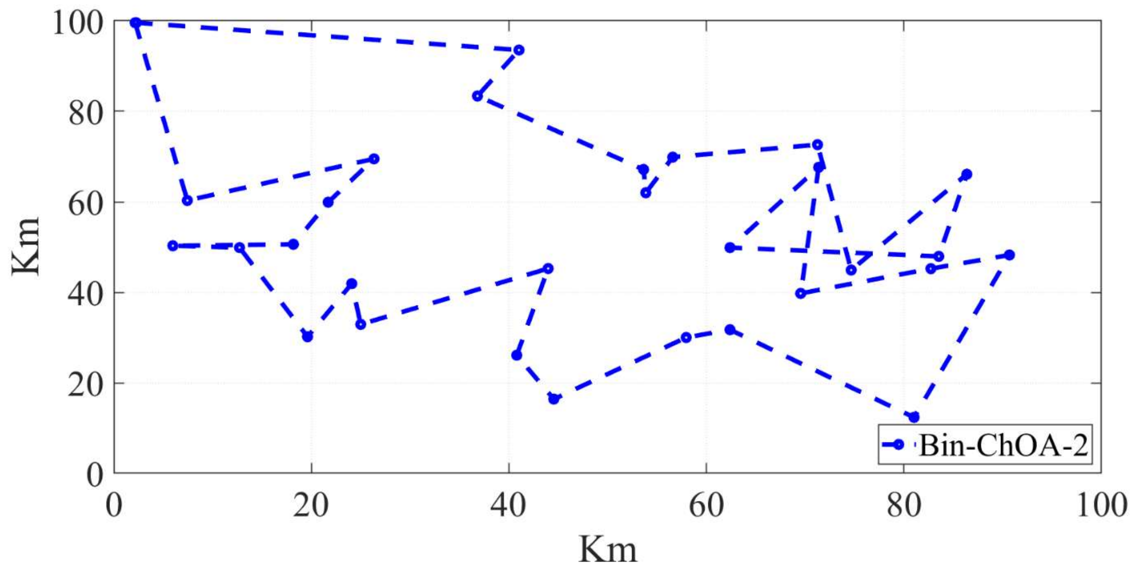

Fig. 16. The best route obtained by Bin-ChOA-2

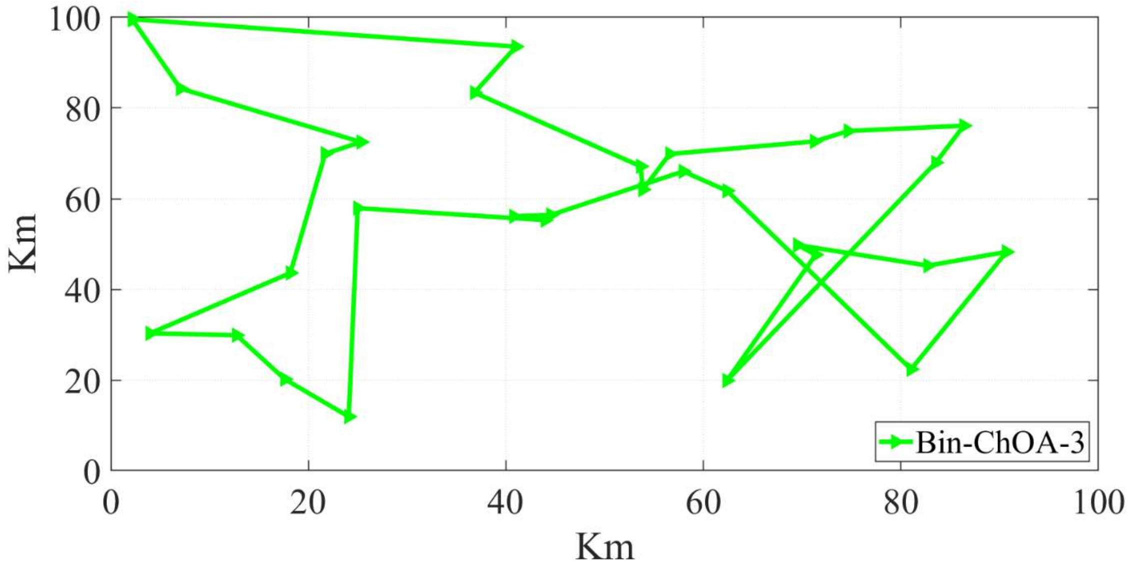

Fig. 17. The best route obtained by Bin-ChOA-3

5. Conclusion

The study investigated the binary ChOA model data mining in tourism path planning and proposes innovatively to include group emotions, which tends to increase the expediency of tourism path planning and utilizes meshes to express the spatial relations between scenic areas and group emotions, using Gaussian function to assert the likelihood of monitoring state, and use the characteristics of scenic spots and group emotions to some extent, it demonstrates that the method is acceptable and satisfies the multi-factor path planning demands of users. However, this algorithm has its flaws. Using the grid model, for example, substituting the real distance also with the Manhattan distance will definitely lead to inaccuracies. In the future, new clustering approaches can be tested to reduce the risk of bias. In the end, the results are more precise.

The information technology sector in China is expanding at a rapid pace these days. Tourism and geographic information systems (GIS) have enhanced information over time, but there is always more to be done. Route selection planning can be expanded to specific road planning in the future with the creation of an optimum national route selection website or decision-making system for travel route queries. Having well-developed and well-maintained tourist routes is critical for guiding the flow and direction of visitors, as well as reducing congestion during peak travel times and enhancing the overall tourist experience, all of which are critical to the growth of China's tourism sector. When it comes to mature research, however, most of the time, the hurdle is fixed, but the circumstance where it evolves with the period is still absent. In the future, this should also be done.

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