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Study of the Spatial Structure Optimization on the Regional Attractions System: A Perspective Based on Fractal Geometry

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ABSTRACT

The spatial combination and characteristics of the attractions system is the basic ingredients for the tourism activities. Its research can help to fully grasp the spatial attribute and interrelationship of the tourism activities, which also create a good foundation for the efficient use of the tourism resources and proper arrangement for the spatial distribution. This paper, based on the method of random aggregation and grid dimension, analyzed the spatial structure of the tourism attractions system in Anqing city. The results indicated that the spatial structure of the local attractions system of Anqing showed its spatial fractal feature with the tendency of self-organization optimization. However, the survey also showed that the spatial structure of the attractions system of Anqing was still at the elementary stage and the adsorption radius of the system was limited, which caused uneven spatial distribution and unsatisfactory combination of products and resources in space. According to the data of the field investigation, the author calculated and analyzed spatial fractal dimension of the local attractions system in Anqing, and then studied on the optimization and integration of the spatial structure of the attractions system in depth. Finally, the optimization was discussed and the strategy such as improving "One core driven by two poles", constructing "core-edge" development zones, speeding up the coordinated construction between the tourism scenic spots and tourist traffic system, promoting the regional network linkage etc were put forward. This research is of full application value for reasonable arrangement of spatial distribution for urban tourism resource and product in Anqing city.
Keywords: Scenic spot system; aggregation dimension; grid dimension; spatial structure; Anqing city.

1. INTRODUCTION

City is gradually playing the vital carrier role to modern tourism instead of traditional function of merely transition centre for tourism. Therefore, spatial characteristics of tourism attraction in city are an significant basis for development and design of urban tourist activity.

In this research, the authors selected large number of small and middle-sized cities in China as the objects for their abundant tour attractions. Meanwhile, there is a great growth in urban economy under the settings of the increase in domestic demands, improvement in transportation and acceleration in original urban-rural integration process,. However, these cities are inexperienced in tour resource development and application. What's more, there are some big difficulties in tour resource development and product design. For instance, they have little awareness in tour resource, and have no specific target in product design, which leads to a poor growth in tourism. Though many cities attach importance in tourism, slow progress in development effect hinders its healthy growth.

There are a large number of research outcomes in urban tour. Owing to the complexity and distinguished original geographic feature, it is feasible to do urban tourism research in some new angles such as complex system science and fractal system, etc. The research involving complexity system science and fractal theory indicates that city and region, nature and culture complex system has the fractal characteristics. As the subsystem of urban complex system, scenic spot system is a multilevel complex system made up by different scenic spot and activities and it is also affected by various natural and humane factors. Hence, it is of full theoretical and practical significance to discover fractal geometry feature and its principle of scenic spot system spatial structure. Theoretically speaking, since the birth of fractal conception in 1970's, it has been widely used in many fields with lots of outcomes. However, comparing with foreign scholars, Chinese scholars witnessed a late start for its application in limited fields, and few in the research on optimized arrangement of regional scenic spot system spatial system.

In the terms of practice, as one of basic elements, attractions with different level, grade and scale connected by various tourist routes and transportations will make a network spatial structure of tourism system. Their inner principle of aggregation degree, scale, mutual connection and function can supply reliable reference for planning of regional tourism system elements and its construction. What's more, it can assist the coordination between elementary factors of regional tourism system and overall network space structure.

Therefore, the authors adopt the theory of fractal in spatial structure analysis in regional tourism scenic spot system. Anqing city of Anhui province is selected in this research, the authors will calculate fractal dimension of spatial arrangement of tour resource and scenic spot by field investigation and data collection. They will also analyze and evaluate present situation of spatial structure in Anqing's attractions with addressing its evolution stage of its tour resource system and go on summarizing the model and strategy on its optimized arrangement and scientific planning of tourism resource space. The purpose is to build scientific basis on effective integration and reasonable planning for tourism resource in Anqing, and offer reference for other small and middle-size cities for their tourism resource integration and transformation.

2. LITERATURE REVIEW

Fractal is an optimized structure, it refers to the objects with similarity in form, function and information, etc. (Lin Hongyi, Li Yinxue; 1992). Fractal involves self-similar fractal among part and the whole in certain way with the core value of "the element displays overall system". Its biggest characteristics is they share the similarity which can be absolute similarity, or the one in statistics sense. (Li Houqiang, Cheng Guangyue; 1990; Wang Fuquan & Li Houqiang,1997) and most of them belong to the latter group.

Mandelbrot (1982) founded Fractal Geometry to analyze spatial fractal feature of city scale. At present, fractal theory has been widely used in various fields of natural and social science. And in social science, it is mainly applied in the research of urban spatial structure and industry aggregation effect, etc. S. Arlinghaus (1986) discussed fractal set characteristics for grade system of central zone. Batty M. (1991)studied city's structure and function with single fractal method. Being an ideal tool on analyzing complexity, nonlinear, self-organized system, fractal theory and method is good at picturing complex system's mixed state of rules and chaos. What's more, it can realize the accurate effect which is impossible for regular statistics approach.

Chinese scholar Liu Jisheng (Liu Jisheng & Chen Tao, 1995) proposed the calculation of fractal dimension of urban-suburb spatial structure, and he also studied on factual features of spatial structure in the city group of north-east region and north of Henan province. Fractal theory achieved some outcome in Chinese geomorphology and human geography. (Ai Nanshan & Chen Rong, 1999; Yue Wenze & Xu Jianhua, 2001) Wang Liangjian (2005) carried out quantitative analysis on spatial structure and transportation network in city group of Changsha, Zhuzhou and Xiangtan. He also addressed its self-organization evolution stage and development tendency. Yangshang and Wang Fa (2007) figured out fractal features of urban-suburb system spatial structure of city group in the middle of China by calculating its fractal dimension. And he discussed the influential factors during its spatial structure evolving process and then finally found some enlightenment for optimization of urban-suburb system spatial structure of city group in middle of China.

In 1980s, fractal theory and method was adopted in the research of system spatial structure of scenic spot. For instance, Bolviken et al. (1992) discovered the existence of self-similar feature after investigating the scenery of North Fenno Scandia Lydian. Bruce T. Milne (1988; 1991) used fractal method in scenery spatial structure study, and he thought it was an effective supplement for traditional statistics analysis. Moreover, it could be used for scenery development and optimal layout to enhance aesthetic value of scenery. Andreas C.W. Baas (2002) simulated scenery environment of dune vegetation along the beach and analyzed its spatial structure and feature. Isabelleb Thomas et al. (2008) studies on scenery spatial feature and explores its evolving process of Wallonia region with fractal method.

Comparatively speaking, Chinese scholars start the research on scenic spot system in fractal theory lately. Chen Tao is the first person to (1996) discusses the aesthetics essence of tourist behavior and scenic spot with the idea of fractal and chaos. Recent years, some scholars studies whether scenic spot exists fractal feature by empirical analysis. Chen Yanguang et al. (1996; 1997; 1999) addressed self-similar characteristic of elements of scenic spot with fractal theory, he also pointed out history chaos process and landform fractal structure could make plenty of tour resource. Dai Xuejun et al. (2005) took scenic spot system as an example, worked on its spatial structure with random aggregation fractal with proving that fact that calculation and analysis of random aggregation dimension was the judgment foundation for self-organization optimized trend of scenic spot. Yang Guoliang et al. (2007) addressed fractal feature of tourism system spatial structure of Sichuan province. And Xu Zhihui et al. (2007) concluded spatial structure of Nanjing scenic spot held favorable fractal feature after fractal dimension calculation according to its self-organization evolving characteristics. Gao Yuanheng et al. (2007) did the research on spatial structure group of Guilin attractions in different time periods by aggregation fractal method based on spatial structure evolving model of scenic spot.[23]

To sum up, many scholars have attached more emphasis on the study of fractal feature of scenic spot system whilst few on spatial structure optimized research based on fractal dimension calculation. Meanwhile, popular tour cities and large regions are the objects to do spatial structure research with fractal theory, while little attention is paid on the middle and small-size city with abundant tourism resource.

3. THEORY AND METHOD

As fractal cannot be measured by regular standard, the effective parameter to describe fractal is fractal dimension and dimension is an important parametric to reflect spatial phenomenon. According to several fractal definitions, with basic features of spatial structure of scenic spot system, the authors plan to analyze spatial structure of scenic spot system with aggregation dimension and grid dimension. What's more, dimension measurement produced by Chen Yanguang, Liu Jisheng et al. (1999) in their analysis of town system fractal features is adapted to study on fractal features of scenic spot system. Aggregation dimension is named as radius dimension for it works with gyration radius, while grid dimension is calculated with regional gridding method.

3.1 Aggregation Dimension

3.1.1 Theory Model

Suppose the elements of scenic spot distribute centers round key spot (the most influential scenic spot in the system) with certain self-similar rules in condensed state. And fractal is changing evenly and isotropically. So it can determine the relationship of the number of scenic spot within the circle with radius $r^{N(r)}$ and relative radius. That is:

$$N(\mathrm{r})\ \alpha\ r^{D_f} \quad \text{(Formula 1)}$$

Similar with dimension format of Hausdorff, D_f is fractal dimension. That is to say, if the assumption is proved to be true, gyration radius methods can be adopted to figure out fractal dimension of spatial aggregation in scenic spot system. Many researches indicate that tour attractions in urban tour resource zone bear self-organization characteristics, so the above assumptions are true. As unit value of radius *r* will affect the value of fractal dimension, it can be transferred to average radius which can be defined as:

$$R_s = \left\langle \left(\frac{1}{s} \sum_{i=1}^{s} r_i^2 \right)^{1/2} \right\rangle \quad \text{(Formula 2)}$$

And the fractal dimension relationship can be shown as:

$$R_s \propto S^{1/D} \quad \text{(Formula 3)}$$

R_s refers to average radius, r_i is the Euclidean distance (barycenter distance) between *i*th scenic spot to center spot. *S* is the number of scenic spot, $\langle \cdots \rangle$ is the average, D is fractal dimension. As D refers to the characteristics of random aggregation of scenic spot around center spot, it is named as aggregation dimension.

3.1.2 Geography Significance

Generally speaking, in two-dimensional space, people take Euclidean fractal dimension 2, $D \prec 2$, when, it indicates that distribution of scenic spot is density decay from central scenic spot to surrounding hinterland. As the strong centrality from center scenic spot, various attractions in the system will aggregate around center scenic spot, and overall tourism attraction of the system is increasing; when $D = 2$, distribution density of scenic spot is constant, and all the spots will circle around the center evenly which is an Euclidean geometry distribution whose fractal characteristics has degenerated with mediocre system structure.; While $D \prec 2$, distribution density of attractions will grow with the increase distance from center spot, then various attractions surrounding the center spot will distribute in discrete state, which indicates attractions distribution is density increasing from center spot to surrounding hinterland. The center spot has no centrality, and tourism attraction power of the whole system is weakening. Meanwhile, this scenic spot system can neither match with regular transportation network, nor can it be embraced by environment system. Hence, it is an abnormal spatial form.

3.2 Grid Dimension

3.2.1 Theory Model

In $d = 2$ dimension Euclidean space, these attractions are distributing with some probability. The whole research region can be divided into 2-dimensional grid, and then people investigate grid number $N(\varepsilon)$ occupied by attractions, obviously, $N(\varepsilon)$ varies with the change of grid size ε. If scenic spot does not have scale characteristics, then there is:

$$N(\lambda\varepsilon) \propto \lambda^{-\alpha} N(\varepsilon) \quad \text{(Formula 4)}$$

and then: $N(\varepsilon) \propto \varepsilon^{-\alpha}$ (Formula 5)

Similarly, just like Hausdorff Dimension format, people know $\alpha = D_0$ as a fractal dimension (capacity dimension). Because it is supposed scenic spot system is an even fractal group without considering the difference of spots in various grids.(Zhu Xiaohua and Wu En, 2007). If observing line is i, row is j, and the number of scenic spot is N_{ij}, the sum of scenic spot in the region is N, then the probability can be roughly defined as $P_{ij} = N_{ij}/N$, there is the information amount as follows:

$$(\varepsilon) = -\sum_{i}^{k}\sum_{j}^{k} P_{ij}(\varepsilon) \ln P_{ij}(\varepsilon) \quad \text{(Formula 6)}$$

$K = 1/\varepsilon$ is the segmentation number of the region, If attractions system is fractal, there is:

$$I(\varepsilon) = I_0 - D_1 \ln \varepsilon \quad \text{(Formula 7)}$$

I_0 is constant, D_1 is fractal dimension(information dimension). So it can attain generalized fractal dimension, and then multi-fractal dimension spectrum D_q (Chen Yanguang, Luo Jing, 1997) All the above dimensions are figured out by gridding which therefore is called grid dimension.

Calculation of grid dimension is similar with that of the aggregation dimension. The reason for selecting matrix area in scenic spot distribution map is people do the research on the whole system, so this region should at least include the research area. If the side length of the matrix region is 1 unit, (take different unit of length and width), all the sides are equally divided into K pieces, and then the researched area is divided into k^2 pieces of small areas, there gets $\varepsilon = 1/K$, ε is size of small region. Firstly authors calculate the number of grid $N(\varepsilon)$ occupied by fractal point (scenic spot). Secondly, they will figure out number of scenic spot $N_{ij}(\varepsilon)$ in every grid and work out probability $P_{ij}(\varepsilon)$, and then the information amount. $I(\varepsilon)$. If ε is changed, people will get different $N(\varepsilon)$ and $I(\varepsilon)$. If the single log coordinate graphs $\ln N(\varepsilon) \sim \ln \varepsilon$ and $I(\varepsilon) \sim \ln \varepsilon$ are made, the no-scale interval is discovered, respectively regressing the straight line of the points and rows $(\ln \varepsilon, \ln N(\varepsilon))$ and $(\ln \varepsilon, I(\varepsilon))$ and then people can work out capacity dimension D_0 and information dimension D_1.

3.2.2 Geographic Meaning

Theoretically speaking, the change of grid dimension value is from 0–2 which reflects the equalization of area's scenic spot distribution. $D = 0$ indicates all the attractions are centering around one spot. The situation of only one scenic spot in the area usually will not happen in the reality.

When $D = d = 2$, it indicates attractions in this area are distributing evenly which is the standard center spot model. As long as Christaller model is breaking with some symmetry, it will show fractal geometry structure. Actually, center spot system implies fractal set characteristics.

Under normal situation, $1 \prec D \prec 2$, the larger D is, the more balanced the spatial distribution of various elements in attractions system will be, and more centered otherwise. When $D \to 1$, it indicates that attractions have centered along a line (such as railway, river, beach, etc.)

Capacity dimension D_0 and information dimension D_1 are usually not the same, their relationship is $D_1 \prec D_0 \prec d$. When scenic spot system is simple fractal, $D_0 = D_1$.

Moreover, if capacity and information dimension are small which shows bigger distribution variation of attractions number among the areas. And big capacity and information dimension indicates smaller distribution variation.

3.3 THE COMPARISON BETWEEN TWO DIMENSIONS

Two fractal dimensions are able to reflect spatial distribution forms of scenic spot elements and the balance of scenery element spatial distribution in system spatial structure. It also can be used to judge the compactness and evolving order degree of spatial structure of attractions system. However, there are some differences between them, aggregation dimension describes scenic spot system elements' form for aggregating key attractions from one correlation of scenic spot density. And grid information dimension describes system's spatial structure attribute directly from distribution of scenic spot.

When random aggregation dimension is adopted to investigate fractal feature of scenic spot system's spatial structure, it also takes degree structure and evolving rules of scenic spot into account. Therefore, when system's degree structure and random aggregating spatial structure is relatively balanced, it shows the system is in the tendency of self-organization optimization. If the random aggregation fractal structure is growing poorly or degenerating, system needs to either adjust its degree structure to meet spatial structure optimization, or adjust its spatial structure to coordinate degree structure's optimization. Hence, random aggregation dimension is the bridge to investigate coordinative relationship between degree structure and spatial structure in attractions system. Grid information dimension studying on fractal feature of spatial structure of scenic spot system can know better about order degree of system spatial structure, self-organization degree of system evolution, compactness and function of system, it is also the basic evidence to judge spatial structure of scenic spot. Meanwhile, Selecting and controlling some variables with studying on the effect of change of one significant variable towards order degree of scenic spot can help to find some specific channel for system optimization. If investigating the effect of some important variables' change to order degree of system, people can figure out inner quantity relation and comprehensive effect of system optimization among these variables.

4. SPATIAL STRUCTURE AND FRACTAL STUDY ON SCENIC SPOT SYSTEM OF ANQING CITY

4.1 Current Situation of Tourism Development in Anqing City

As a central city of south west of Anhui province, one of the key cities of "developing area along Wan river", Anqing is well-known as an important port along Yangtse River, and home of Huangmei opera, one of traditional dramas of China. Locating in the geometry center of attractions such as Huangshan, Lushan, Jiuhuashan, etc., it is proud of long history and various landforms such as mountain, river, rock and cave, etc. There are a lot of historical sites as well. For instance, there is renowned Tianzhu Mountain which is a national resort. There are also 6 provincial-level attractions, 47 provincial-level antique safeguarding sections and 3 provincial-level historical and cultural cities. What's more, Anqing is one of key cities with open-up policy, national first-class port and open port for foreign steamship. In addition, Hejiu railway goes through 5 cities and counties by connecting with big Jingjiu railway. And there opens flight route to Beijing, Guangzhou, Wuhan, Xiamen and Shanghai, etc. Abundant natural and humane scenery views with convenient transportation network and favorable geographic location make Anqing a prospective and new tourist city.

However, differing with other famous tourist city, Anqing is a distinctive and new tourist area with few relevant tourism researches, especially the study on tourism spatial structure and tourism industry development effects of Anqing in quantitative and qualitative approach. Hence,this study will adopt aggregation dimension and grid dimension in fractal theory to work on Anqing's scenic spot system. And it is expected to have quantitative evaluation on present arrangement, and then propose optimized scheme to offer reference to comprehensive reform and sustainable development of tourism in Anqing.

4.2 Fractal Dimension Calculation

According to the statistics of main attractions issued by tourist website of Anqing city with investigation of the developed attractions, people eventually chose 14 regional scenic spots, including Tianzhu mountain, Huting lake, Yingjiang Temple, Shilian Cave, Peacock Flying Southeast theme park, Xizi lake, Xiaogu hill, Duxiu garden, 5-thousand-year historical and cultural park, Miaodao hill, Dalong mountain, Sikong Hill, Tianxian river and Giant stone mountain. The statistics is attained from GPS calculation and Google earth on their specific locations and worked out by social-statistics software SPSS17.0.

4.2.1 Calculation of Aggregation Dimension

According to the evolution rule of scenic spot system with taking geometry center into consideration, the authors selected Tianzhu Mountain as the measurement center of scenic spot system of Anqing.

Firstly, the authors will measure the gravity distance r_i of all attractions to Tianzhu Mountain from proximal to distal. Secondly, it will be transferred to average radius R_s, and get a series of by changing S (see Table 1), Thirdly, they will make the point into ln ~ ln single log coordinate graph (see Figure 1) and finally get the value of aggregation dimension *D* by least square method.

Table 1: Calculation of aggregation dimension of anqing attractions system

Name of Attractions	*S*	r_i *(km)*	R_s *(km)*	*ln S*	*ln* R_s
Tianzhu Mountain	1	0	0	0	0
Tianxian River	2	20.5	14.496	0.693147	2.673873
Peacock Flying Southeast theme park	3	22.4	17.531	1.098612	2.863971
5-thousand-year historical and cultural park	4	33.0	22.422	1.386294	3.110043
Huating Lake	5	33.8	25.114	1.609438	3.223425
Miaodao mountain	6	35.0	27.014	1.791759	3.296355
Sikong mountain	7	46.0	30.459	1.945910	3.416382
Duxiu Garden	8	54.6	34.416	2.079442	3.538522
Xizi Lake	9	55.4	37.334	2.197225	3.619904
Gaint Stone mountain	10	59.8	40.151	2.302585	3.692647
Dalong Temple	11	60.5	42.406	2.397895	3.747290
Yingjiang Temple	12	61.8	44.347	2.484907	3.792045
Shilian Cave	13	74.3	47.329	2.564949	3.857123
Xiaogu Mountain	14	87.2	51.217	2.639057	3.936072

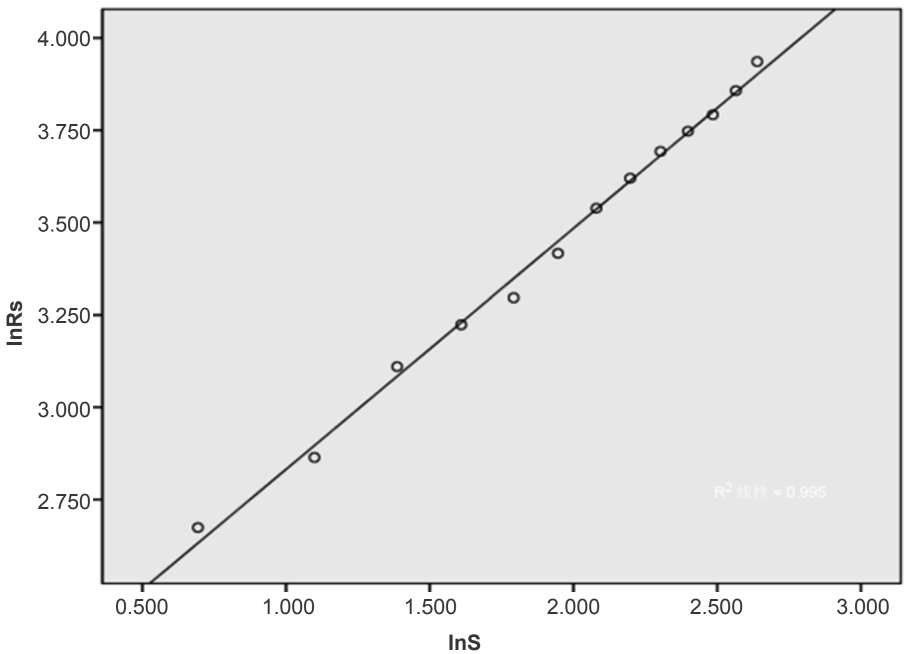

Fig. 1: *Single log coordinate graph of aggregation dimension of anqing scenic spot system*

From Figure 1, we can see that there exists no-scale interval in Anqing tourism attractions system ranging from 0.693 to 2.639 with obvious aggregation fractal characteristics. If having linear regression on the scattered points in no-scale interval, we can have:

$$\ln R_s = 1.156 \ln S + 1.11 \quad \text{(Formula 8)}$$

Then we can get relevant coefficient $R = 0.9$ ($n = 14$, $R_{0.05} = 0.532$) determination coefficient $R^2 = 0.810$ and the value $R^2 = 0.794$ after adjustment, and sig = 0.000. After test, there is a good general fitting effect. Aggregation dimension value of Anqing scenic spot system is $D = 1.156 \prec 2$, which tells the strong random aggregation of spatial structure in Anqing attractions system. As there is different centrality in various attractions' spatial structure, the density form Tianzhu Mountain, the center scenic spot, to peripheral spot is weakening quickly with small adsorption radius.

4.2.2 Calculation of Grid Dimension

According to google earth, the authors make the matrix frame with taking the north of Daguan county of Tongcheng city as the north boundary, the south of Huikou town of Susong county as the south boundary, the east of Laozhou town of Congyang county as the east end, and west of Wangtian town of Taihu county as the west end, longitude and latitude is about: $115.82°\text{E} \sim 117.67°\text{E},\ 29.82°\text{N} \sim 31.23°\text{N}$. There are 14 scenic spots in the area, then $N = 14$.

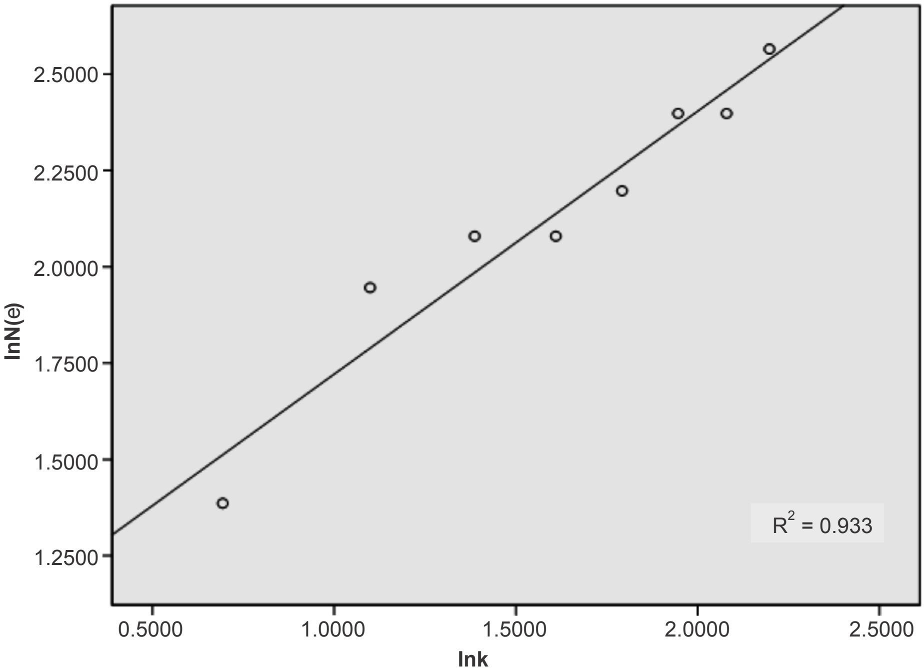

Fig. 2: *Single log coordinate graph of grid capacity dimension of Anqing scenic spot system*

According to the formula of above grid dimension, the authors will have grid segmentation for distribution map of scenic spot system to obtain the statistics of information dimension. (see Table 2) and these basic statistics will help to make a graph for two kinds of grid dimension of scenic spot system. (see Figure 2 and Figure 3), then get grid capacity dimension $D_0 = 1.31$, determination coefficient $R^2 = 0.933$, grid information dimension $D_1 = 1.22$ and determination coefficient $R^2 = 0.979$.

From Figure 2 and 3, we can conclude that there exist obvious no-scale characteristics in certain estimated degree of Anqing scenic spot system, that is fractal structure. Mathematically speaking, spatial structure of the system is fractal. As $D \to 1$, we can know distribution of scenic spot is relatively centralized and easy to form route package.

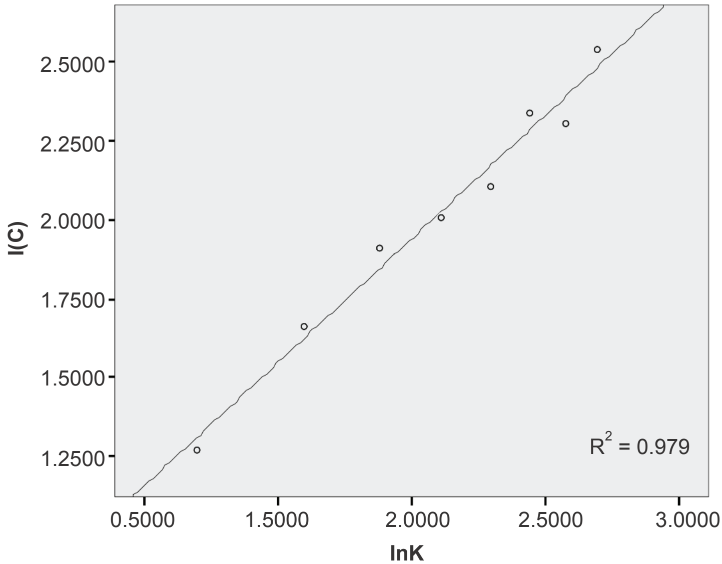

Fig. 3: *Single log coordinate graph of grid information dimension of Anqing scenic spot system*

4.3 Handling with Errors

Counting is the first issue should be taken into consideration. As for the measurement of aggregation dimension, something involving counting should be paid attention to:

Firstly, according to the mathematics meaning of formula (2) and (3), central scenic spot should be excluded when calculating partial *S*. But experience tells us the calculation result will be better with including central scenic spot. So considering relativity of dimension application, central scenic spot is usually taken into account;

Secondly, fractal dimension of scenic spot dimension is changed with the point, though the characteristics should be taken into consideration in application analysis, it can be neglected in theoretical research.

Thirdly, projection has some impact on calculation. Among all the maps, the best choice is isometric projection, the second choice would be equal-area projection, and conformal projection will make the biggest error. As the calculated area of Anqing is small, its projection can be regarded as horizontal projection with neglecting the error.

4.4 Analysis and Discussion

Attractions system of Anqing shows obvious aggregation fractal characteristics, and its spatial structure has optimized tendency. Because Tianzhu Mountain, as the core of Anqing tourism region, is more famous than other spots, plus aggregate's shielding effect, it is always the center of spot aggregation. What's more, similar evolving constrained condition of scenic spot makes standard aggregate fractal structure. (Kaye B.H., 1989) However, as there are two more famous scenic spots such as Huangshan and Jiuhuashan in south east of Anhui province, which lead to its limited adsorption radius with aggregating small area around it. Moreover, As the center of hierarchical structure of Anqing tourism system, Taizhushan doesn't coincides with its center of spatial structure, which indicates this system is still at the elementary stage of self-organization optimized tendency.

On the one hand, if grid dimension calculation value is from 1 to 2, it indicates overall attractions system displays the characteristics of center spatial distribution of scenic spot with compact spatial structure and obvious self-organization optimized tendency. If the value is close to 1, we can conclude the regional attractions spatial distribution is the aggregation along some directions, which can be proved that more local famous scenic spots are distributed along the national freeway network. On the other hand, small capacity dimension and information dimension of scenic spot system indicates large change of distribution probability of scenic spot number in region segmentation, and spatial distribution is not even for aggregating distribution in it. Therefore, fractal is relatively complicated, which is closely related with geography spatial structure of Anqing city. Because there are Yangtze River's branches in southeast with rich tourism resource, a lot of water-related attractions are involved, such as Yingjiang temple, Xizi lake, etc. There is mountain landform in northwest with the attraction from Tianzhu Mountain, there forms small aggregation group. But in terms of the whole tour scenic spot system, as small region area, the difference of these two parts have small effect to self organization optimization of the whole system. Therefore, active tourism resource planning and spatial structure optimization with strengthening relevance degree among various attractions can promote coordinative development of this region and encourage its grouping advantage of tourism system.

4.5 Spatial Optimization of Tourism Attraction of Anqing

As representatives of middle and small-sized tourism city, Anqing's tourism is restrained by tour resource and geography structure, and its spatial structure of scenic spot is still at primary stage of self-organization optimization. In terms of spatial structure optimization, people should deal with the issues on functional positioning of scenic site, tour networking and tourist market industry chain. Only considering at the angle of Anqing's overall tour spatial pattern could we have feasible and scientific solution. The strategies are as follows:

(1) **The strategy of "one core driven by two poles"** Though Tianzhu Mountain is regarded as the center scenic site, it is not locating in the geometry center of Anqing scenic spot, which weakened the adsorption of center scenic site with limited adsorption radius. What's more, in homogeneous spatial distribution makes two separated aggregation in the system, which is one on northwest and another on southeast. Therefore, spatial structure optimization should accord with system's fractal characteristics with taking Anqing's spatial pattern, present tour resource type and quality, development potential and location into

consideration to strengthen adsorption radius of core scenic site to form the tour attraction spatial structure system of "one core driven by two poles."

Tianzhu Mountain is national scenic spot; it bears certain brand effect, so its radiation function as the core area should be emphasized to encourage tour development of Anqing city. Secondly, Anqing's future tourism development should adopt the strategy of driven by two poles, that is, taking the famous mountain and cultural heritage site in north-east and beautiful water and historical temple in southeast as two poles to form Anqing's new pattern of tour resource space.

(2) **Reasonable planning, constructing "core-edge" development zone** John Friedman thinks any spatial economic system can be divided into core zone and marginal zone with different attributes. (Friedman J.R.,1966) This theory attempts to explain how a isolated and unbalanced region turns to be correlated and balanced region system. The spatial development process of tour system is also a contradictory movement process from unbalanced to mutual-balanced development. Hence, Anqing future tourism development should have reasonable planning with the key development zone to encourage marginal area to further improve the disparity phenomenon of "core-edge". Therefore, the number of new scenic sites and choice of spatial location should be strictly controlled, and people can fully cultivate the potential of scenic site in marginal zone. And people can also increase scenic spot properly under the setting of "aggregation economy" with scientific planning.

The calculation result of random aggregation fractal dimension indicates that Anqing is still at the elementary stage of self-organization optimization. Though spatial cohesion model is forming, its aggregation effect has not given full play. In future development, core aggregation zone should plan the new attractions and adjust the old scenic spot with the requirement of theme coordination, spatial connection and market supplement. What's more, in the marginal zone, Shilian cave and Xizi lake should be promoted as the brand to stimulate the construction of infrastructure and service facility to form a complete regional tour image. So it can motivate the growth of other attractions which can integrate core tourism development pattern to remiss disparity situation between edge zone and core zone.

(3) **Making full use of transportation system to form scenic spot spatial network system covering the whole city** Development level of regional transportation network construction is the basis to realize scale and sustainable development of area tourism economy. The accessibility, road quality, traffic information construction and service level will play profound roles on tourists' choice, tour route organization and tour experience (Zhang Xingping, Yan Jianjun, Mao Bilin, 2000).

Though Anqing's location makes a favorable transportation system construction environment, it needs improvement in the coordination with scenic spot system. From internal connection of tourism system, it is necessary to improve Anqing tourism transportation network, optimize inner transportation network structure, increase mutual adsorption probability among attractions to form a single and larger scenic spot group which can reduce shielding function of center site to increase the overall outwards cohesion function. In terms of the external, coupling degree between partial tour attraction system and tour transportation system requires further development. So it is suggested to promote the connection between new attractions or existing spots to surrounding sites, especially the unblocked network for high-grade high way and freeway for accessibility is an important criterion for tourists' perception to tour destination which plays an important role on tourist's choice.

(4) **Constructing local industry chain with tour resource characteristics** One of regional tour development tendencies is network growth of tour destination. With the linkage among regions and industry chain as the condition, people will expand the connection among various tour areas to achieve mutual development. (Li Yuejun, 2006) As Anqing's tourism industry chain has not yet formed, tourism enterprises are still small, weak with poor service, high regional tourism cooperation degree and level is desirable. Since Anqing scenic spot is a comprehensive tour zone with cultural and natural scenery, the tour resource shares something in common, we need to emphasize the characteristics of each scenic spot to avoid repeated construction and improper competition, complete tour product pedigree such as sightseeing tour product, leisure tour product, business conference tour product and recreation tour products

CONCLUSION

Some ideas can be concluded from above analysis:

(1) It is possible to study scenic spot system spatial structure with fractal approach.

(2) The investigation on two kinds fractal dimensions indicate spatial structure of Anqing's scenic spot system is fractal with the tendency of evolving self-organization optimization.

(3) In terms of random aggregation fractal dimension value, spatial structure of Anqing scenic spot system has strong random aggregation, the density from aggregate center to surround attractions attenuate quickly. However, because degree center and spatial geometry center is misalignment, spatial fractal structure is still at elementary stage.

(4) From grid dimension, scenic spot distribution of Anqing scenic spot system is centralized with high order degree, compact spatial structure and tendency of self-organization optimization. The value is close to 1 which indicate the scenic spot's spatial distribution is the aggregation along some direction.

(5) In order to solute the problem at elementary stage of self-organization optimization in Anqing scenic spot system, people can enhance regional overall tour image by adopting strategy of "One core driven by two poles", constructing "core-edge" development zone, speeding up coordination between scenic spot and tour transportation system and promoting regional network linkage.

Main contribution of this essay contains (1) Fractal theory is adopted to study on spatial distribution measurement of scenic spot system, it is able to discover the evolving situation in the process of self-organization development, and quantitative approach is adopted in spatial structure study. (2) The analysis of tour development in destination helps to conclude that it is feasible to use fractal theory to study on spatial structure, and it also can display system's structure situation and disparity tendency so as to offer scientific reference to scenic spot spatial structure optimization to promote harmonious growth of regional tourism. (3) The author selected Anqing city as an example to study on scenic spot system's spatial structure optimization. Hence it is a good case for tourism spatial structure optimization in small and middle-sized city with offering precious reference for the connection between integration of tourism resource and development of industry in larger area.

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