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Spatial Genetic Mapping of the Dong Settlement in Tongdao, Hunan

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ABSTRACT: Through investigating spatial genetic mapping, the current study reveals the inherent laws of the growth and development of traditional settlements. Factors affecting the growth and development of traditional settlements and the genetic mapping of spatial layouts were explored and summarized through a case study based on the Dong settlement of Tongdao County, Hunan Province. Visualization and quantification assistance of computer analysis techniques were employed. The extraction and analysis of the spatial rules of traditional settlements not only contribute to a greater understanding of the unique spatial-composition logic and development methods of traditional settlements, but also generate high application value for the planning and design, cultural protection, and revival of rural settlements. Furthermore, the establishment of a spatial genetic mapping research system provides valuable clues and guidance for the inheritance and development of traditional rural culture and rural planning in the new era.

KEY WORDS: Tongdao County, Hunan Province; Dong settlement; spatial genetic map; quantitative research

Introduction

The word "gene" comes from Greek, meaning "birth". It refers to the DNA sequence that contains the genetic information of organisms and is the basic genetic unit that controls the growth of organisms. Genes can be classified into ribonucleic acid (RNA) and deoxyribonucleic acid (DNA).

The concept of "cultural gene" (in English: Meme) refers to the basic unit used to explain cultural inheritance, in contrast to biological genes. It was first proposed by British ethologist Richard Dawkins in his bookThe Selfish Gene. Zhao Chuanhai [1] summarized previous research and suggested that cultural genes are the unity of vibrant cultural traditions and potentially revived traditional cultures. They serve as the fundamental link in intergenerational cultural transmission.

The "settlement landscapegenetic mapping" is proposed by Liu Peilin [2-6] based on the cultural landscape and cultural genes, focusing on the study of the genetic spectrum of human settlements. Different from the concept of "cultural genes," the "settlement landscape genetic mapping" includes not only social and cultural factors such as traditional culture and cultural traditions, but also natural environmental factors such as terrain, landform, zone, precipitation, and other factors. The research mainly classifies and refines the landscape cultural genes of settlements in different regions from aspects such as residential characteristics, totem symbols, public buildings, and reference environmental factors.

The study of landscape gene mapping is of great val-

[The format of citation in this article]
LI Xin, YI Lingjie. Spatial Genetic Mapping of the Dong Settlement in Tongdao, Hunan[J]. Journal of South Architecture, 2025(2): 12-24.

Document Identification Code A **DOI** 10.33142/jsa.v2i2.16525 **Article number** 1000-0232(2025)01-012-13

ue for the protection, analysis, and planning of traditional settlements. However, existing research mostly focuses on qualitative research, such as extraction, classification, and recognition. The "spatial genetic mapping" proposed in this article aims to count, analyze, and extract the specific characteristics of settlement landscape genes from the quantitative data obtained from settlement surveys, so as to describe the objective laws of growth, development, and layout of traditional settlements. More effective simulation and prediction of the development of traditional settlements are of great significance to the protection, development, and planning of settlements.

The concept of "spatialgenetic mapping" in this article draws on the concept of "settlement landscape genetic mapping" but also differs in certain aspects. The similarities lie in both concepts incorporating two major factors: "social culture" and "natural environment." However, there are the following differences in the specific selection of the two types of factors:

(1) The concept of "settlement landscapegenetic mapping" includes abstract cultural concepts such as landscape and totem, while the genes selected in this article are specific, visible, and quantifiable.

(2) This article needs to consider not only the "qualitative" genes such as terrain and landform characteristics in the study of "settlement landscape genetic mapping" [3], it is also necessary to consider "quantitative" gene types such as slope, orientation, elevation, and hydrophilicity. Through scientific mathematical and statistical analysis of selected genes, we can understand the distribution patterns of settlements.

(3) The concept of "settlement landscapegenetic mapping" includes multi-level cultural content such as text, symbols, artifacts, and architectural decorations, while the influencing factors related to the formation and development of settlement spatial layout are the main focus in this study. Therefore, the selection of genes focuses on the extraction of relevant elements such as the three-dimensional layout of buildings, (social and spatial) structural characteristics, and settlement central points.

In summary, the "spatialgenetic mapping" in this article draws on the concept of "settlement landscape genetic mapping" and, on this basis, limits the scope of the gene mapping extraction: specifically referring to the specific, visible, and quantifiable genetic characteristics of social cultural and natural environmental factors that influence the spatial layout of settlements.

1 Research Background

1.1 Brief Introduction to Tongdao Dong Settlement

Tongdao Dong Autonomous County is located at the southernmost end of Huaihua City, Hunan Province, bordering Guangxi and Guizhou. It is a major gateway to southwest China and one of the main settlements of the Dong ethnic group. Due to its mountainous location and limited transportation, it has been less influenced by Han culture. So, the traditional customs, culture, and ethnic characteristics of the Dong villages are relatively well preserved.

The Tongdao Dong settlement is nestled amidst picturesque mountains and rivers. Stretching along the river, the "ten-mile Dong Villages" are adorned with iconic wind and rain bridges arching over the water. Drum towers stand at the heart of the villages with stacked eaves and soaring spire piercing the azure sky. The stilt houses are lined up one after another. There are fish ponds all around the village, and the village roads are rugged, mostly paved with pebbles or slabs of stone. In the valleys near and far, pavilions are built, and low wooden benches and stone pillars are placed. Wells are also dug, and springs are diverted to provide resting spots and drinking water for travelers to quench their thirst (Figure 1).

1.2 Relevant research

Liu Peilin, Hu Zui, Shen Xiuying, and others have conducted relevant theoretical and practical research [2-6] on the identification and extraction of the settlement landscape gene map. Liu Peilin discussed the identification and extraction methods of landscape genes, and Hu Zui proposed the concept of establishing an information map prototype system and a map database. Shin Xiuying and others discussed the framework design of landscape gene maps.

Figure 1 Typical Dong settlement style (Hengling Village)

Quantitative analysis is the basis of the spatial genetic mapping analysis in this article, and it has also been an emerging topic in the field of traditional settlement research and historical and cultural protection in recent years. Analyzing and understanding the growth patterns of traditional settlements has great reference and guiding significance for modern urban and rural planning and design. It is also very helpful for us to understand and inherit traditional regional culture in a rational, systematic, and scientific manner. GIS (Geographic Information System) is one of the main methods of quantitative analysis (Table 1) [7-11], and this type of analysis mostly focuses on macro-level geographic information analysis. At the same time, some scholars have proposed other feasible quantitative analysis methods based on buildings and street scales (Table 1). [12-16]

Table 1 Related research literature

Classification	Author	Time	Title	Main content
Extraction and construction ofthe settlement gene map	Liu Peilin	2003	Gene expression and identification ofcultural landscapes in ancient villages	Methods for extracting landscape gene maps
	Hu Zui et al.	2009	Study on Gene Mapping Units of Traditional Settlement Landscapes	Design of landscape gene systems and map units
	Shin Soo-young et al.	2006	LandscapeGene Atlas: A New Perspective on the Study of Settlement Cultural Landscape Flora	Research on landscape gene mapping framework
GIS Settlement Spatial Map Analysis	Lv Jing	2017	Study on the suitability of settlement spatial distribution based on a quantitative model: A case study of Luohe City, Jilin Province	GIS macro-level analysis of factors including altitude, water system, water source, slope, road, and railway factors
	Zhang Hai	2014	GIS and Archaeological Spatial Analysis	Comprehensive Introductionto GIS Archaeology
	Wang Yansong	2012	Study on the Quantitative Method of the Spatial Settlement of Bala River Mountain Settlement	GIS and space syntax are used to analyze settlement landscapes, settlement forms, streets, public space accessibility, and building background.
	Shan Yongbing	2012	GIS-based suitability analysis of rural settlements in Xuzhou	Analysis of natural factors, environmental factors, and social and cultural factors of the GIS settlement
	Liu Jianguo	2006	Settlement archaeologicalresearch supported by spatial analysis technology	GIS archaeology slope, viewshed, buffer zone analysis
Other methods for settlement spatial map analysis	Yang Dinghai	2017	Quantitative study on the changes of traditional settlements in Haikou Meishe Village	Quantitative study of settlement boundaries, building density, courtyard ratio, and fractal index
	Xie Dan	2015	Quantitative research on the boundary shape of rural settlements in Qiongbei	Study on the methods of defining and analyzing settlementboundary shapes
	Shen Yao	2011	Application of quantitative analysis of external space of traditionalresidential settlement based on graph theory	Study onspatial syntax and shortest path in Xidi Village

2 Research framework

The research content of thisarticle is divided into two parts:

(1) Detailed data collection of Dong villages was conducted through literature review, field research, drone aerial photography (Figure 2a), three-dimensional model reconstruction (Figure 2b), and CAD floor plan drawing, with precise three-dimensional positioning of each building in the settlement (Figure 2c).

The author conducted field research in 13 Dong villages in Tongdao (Figure 3). Among them, there arethree mountainous villages and 10 flat-land villages (Table 2). Among them, several Dong villages, including Yutou Village, Banpo Village, Huangdu Village, Hengling Village, Pingtan Village, Yanglan Village, Gaotuan Village, and Gaobu Village, are located in the Pingtan River Basin. Shangxiang Village and Chentuan Village are located in the Boyang River Basin, distributed north and south of Boyang Town. Donglei and Yanshang villages are located on the south side of Longcheng Town and at the foot of Chengya Mountain.

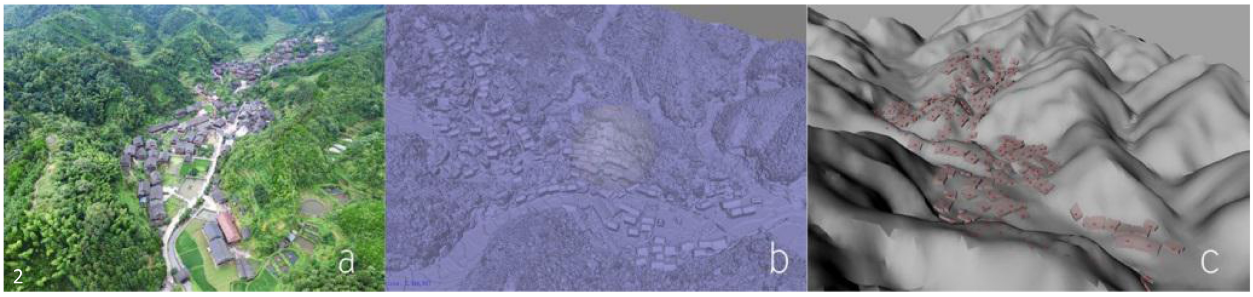


Figure 2 Data collection of Yutou Village

(2) The genetic factors that affect village growth are extracted, and visualization, quantitative analysis, and statistics are performed based on the three-dimensional model. This article adopts a quantitative analysis method based on Rhino three-dimensional model programming (Figure 4).

Figure 3 Distribution map of surveyed villages in Tongdao County

Table 2 List of surveyed villages

Mountainous Village	Flat land Village
Yutou Village, Yanshang Village, Banpo Village	Huangdu Village, Pingtan Village, Gaotuan Village, Shangxiang Village, Hengling Village, Yanglan Village, Gaobu Village, Chentuan Village, Donglei Village, Zhongbu Village

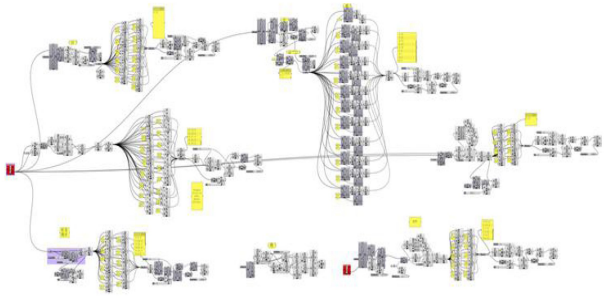


Figure 4 Screenshot of the quantitative analysis program (grasshopper)

Traditional GIS analysis methods are often based on the overall environmental analysis of macro-scale settlement elevation models, while the quantitative analysis in this article isbased on the three-dimensional data of each building point in the building layout of the existing settlement (Figure 2 right). The site selection and layout of the existing buildings are the crystallization of the wisdom of the Dong village residents in adapting to and transforming the environment in their lives. Therefore, the data extrac-

ted and the analysis results in this article can better represent the connotation of the cultural genes of the Dong settlements than the traditional GIS analysis methods, offering greater reference value for understanding the spatial laws of these settlements.

3 Research on spatialgenetic mapping

3.1 Map construction indicators

There are many factors that influence the formation and development of traditional settlements. Many scholars have analyzed the factors that influence the growth of traditional settlements, which provides a valuable reference for the extraction of influencing factors in this article[7-17].Summarizing previous studies, the factors affecting the growth and development of traditional settlements can be divided into two types: natural environmental factors and social and cultural factors. Natural environmental factors include external influencing factors such as the location of the settlement, terrain and landform, water sources, climate, and vegetation. Social cultural factors include internal influencing factors such as economic development, social organization, clan beliefs, farming radius, transportation, and population.

The influencing factors focused on in the spatial genetic mapping of this article include three main factors: hydrophilicity, social interaction, and Kinship Topology. Among them, hydrophilicity belongs to the natural environmental factor, which can reflect the relationship between the settlement and the water sources. Social interaction and Kinship Topology are social and cultural factors. The social interaction factor reflects the relationship between households, while the Kinship Topology factor can well reflect the closeness between families with different blood relationships.

3.2 Research on hydrophilicity maps

Water-friendliness is a major characteristic of the traditional settlement site selection and layout. The Dong people are an ethnic group whose main livelihoods are rice farming and artificial forestry. In choosing their place of residence, they follow the basic principle of being close to mountains and rivers. From the perspective of survival, rice farming cannot be separated from water[18].Compared with flat land settlements, the water sources in traditional mountainous settlements mostly come from mountain streams, with smaller flows and narrower water surfaces. Therefore, unlike the flood control layout of flat land settlements, which often maintain a certain distance from rivers, mountainous settlements have a closer relationship with water sources.

The hydrophilicity analysis adopts the distance method, with the shortest distance from the center of the building to the river boundary as the hydrophilicity index. Thesmaller the distance, the higher the hydrophilicity level. The method of drawing a hydrophilicity analysis diagram is to first draw the central point of all buildings (Figure 5 left), then draw the corresponding nearest point of the river (Figure 5 center), and connect the central point of the building with its nearest point of the river (Figure 5 right) to obtain a visual analysis diagram of the hydrophilicity factor. The longer the line between the center of the building and the nearest point of the river, the redder the color, while the shorter the line, the bluer the color.

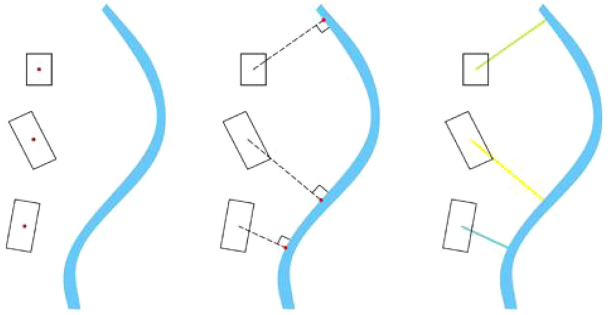


Figure 5 Schematic diagram of hydrophilicity analysis

Usually, the water sources in mountainous settlements come from mountain streams, which have smaller flows and narrower watersurfaces and have a closer relationship with the water sources, which is quite different from the flood control layout of flat land settlements. Therefore, this article separately discusses the hydrophilicity of the two settlement types, comparing the hydrophilicity of mountainous and flat land settlements through grouping and analysis, exploring the similarities and differences in hydrophilicity between these two landform types (Figures 6 and 7). Among the mountainous settlements surveyed by the author, Yanshang Village does not have a noticeable surface water source and thus is not included in the statistical scope.

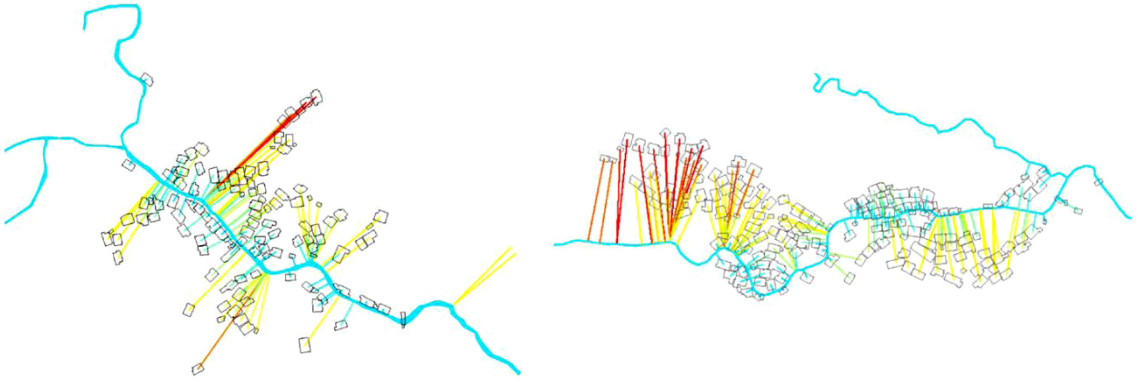


Figure 6 Analysis of hydrophilicity of mountainous settlements

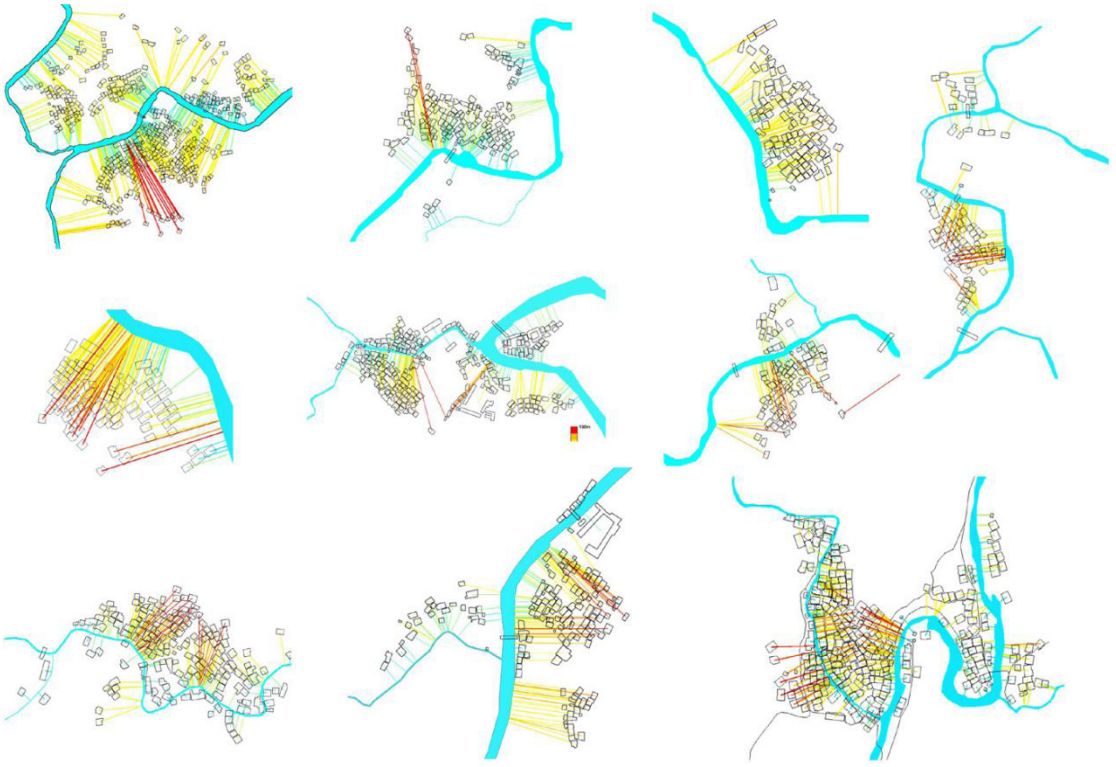


Figure 7 Analysis of hydrophilicity of flat land settlements

Take the visualization analysis results of Yutou Village, a typical mountainous settlement, as an example (Figure 8). The hydrophilicity of mountainous settlements is generally higher, with a predominantly blue-green color, and the hydrophilicity distance distribution of building complexes shows a regular and uniform change. The quantitative analysis results confirmed the above relationship: the closer to the river, the more buildings there are, and the farther away, the fewer buildings there are.

Based on the scatter plotreflecting the changing relationship between the number of building points and social distance, the distribution curve of the hydrophilicity of the house was obtained using the nonlinear fitting method. The hydrophilicity factor of mountainous Dong villages was analyzed through Gaussian nonlinear fitting, yielding the fitted curve of mountainous settlements (Tables 3 and 4). The curve equation is as follows:

$$y= y_0+ A\times\exp(-0.5\times((x-xc)/w)^2)$$

The fitting results of Banpo Village and Yutou Village show a higher hydrophilic gene map of mountainous Dong villages: a concave downward curve. The highest peak of the curve is between 0 and 5m. Then the line shows a rapid downward trend and falls to a trough at around 200m. This result vividly reflects the distribution

pattern of the building layout of the mountainous Tongdao Dong village as the hydrophilic distance changes, i.e., the closer to the water flow, the more houses there are.

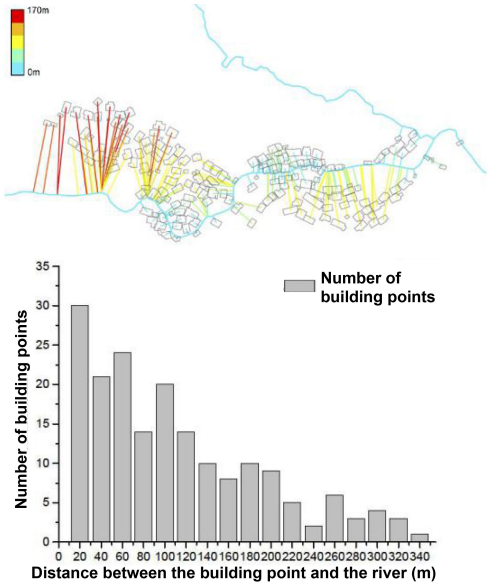


Figure 8 Results of hydrophilicity analysis

Table 3 The hydrophilicity fitted curve of Banpo Village

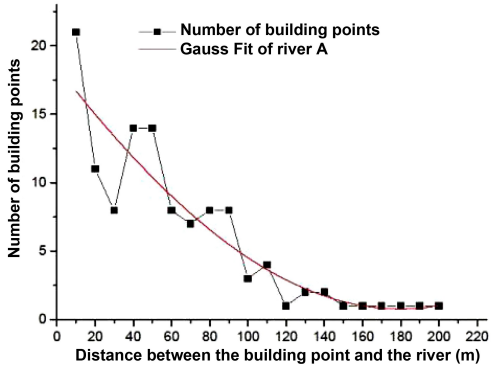
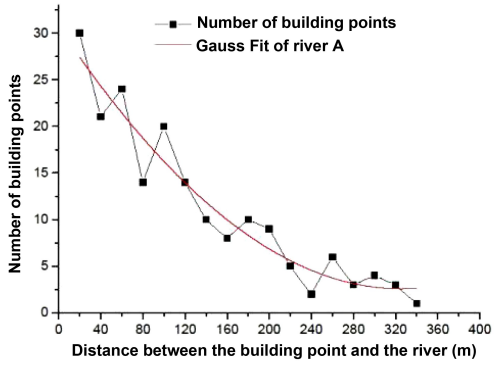


Table 4 The hydrophilicity fitted curve of Yutou Village



The hydrophilicity analysis of flat land type villages shows different statistical results from that of mountainous villages (Figure 9). It shows the typical hydrophilic characteristics of flat land settlements. Take Gaobu Village as an example (Figure 9): the closer to the river, the fewer buildings there are. The largest number of buildings is within the range of 80-90m from the river. After 90 meters, the number of buildings decreases. The hydrophilic distance of the building farthest from the river is 200m.

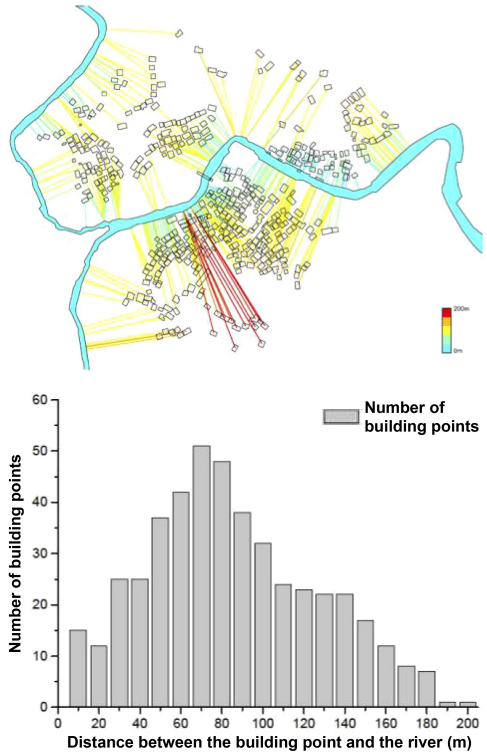


Figure 9 Hydrophilicity analysis of Gaobu Village

The Gaussian curve fitting results of Gaobu Village and Hengling Village (Tables 5 and 6) of typical flat land Dong villages show the high hydrophilicity characteristics of flat land Dong villages: the curve is wavy with high center and low ends. The number of buildings is relatively low, between 0 and 20m. It then shows a rapid upward trend, reaching a peak at around 60-80m, and then falls to the bottom at around 200m in a downward trend. This result vividly reflects the distribution pattern of the building layout of flat land settlements as the hydrophilic distance changes, i.e., the tendency to maintain a distance from the river and select locations on secondary terraces.

3.3 Research on social interaction maps

Social interaction refers to the communication between people in society. It isa social activity in which people use certain methods or tools to transmit information and exchange ideas. In the process of settlement formation, the social relationships between people largely define the physical architectural form of the settlement.

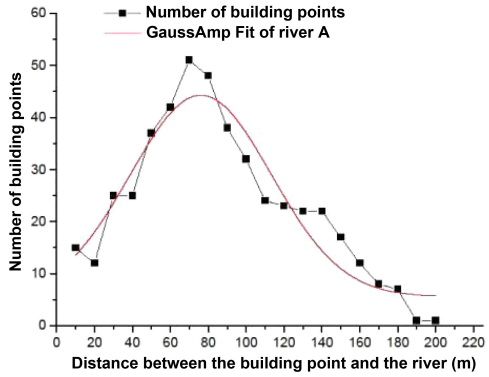


Table 5 Hydrophilicity fitted curve of Gaobu Village

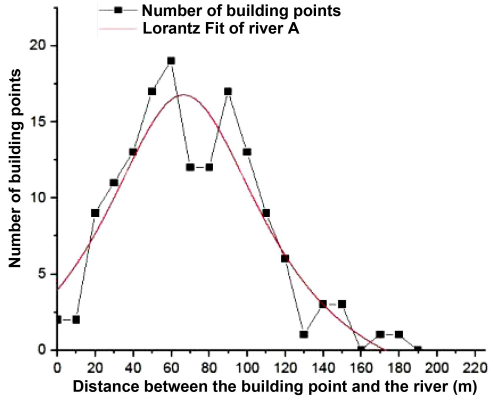


Table 6 Hydrophilicity fitted curve of Hengling Village

Geographers usually divide settlements into two types: clustered villages and scattered villages, according to the degree of concentration or dispersion of settlements [19]. The Dong ethnic group settlements are typical clustered villages where people live together based on blood ties and clan ties. The social relations between clans and between villages are close due to common clan, production, and defense needs (Figure 10). Dong villages and tribes have rich collective social activities between villages, such as the Moon Festival (Figure 11 left), Song Festival, and Bullfighting Festival, among others. The daily social activities of the Dong people are carried out around public spaces such as the drum towers, open spaces, pavilions, wells, and wind and rain Bridges (Figure 11, right).

Figure 10 The "social" relationship of buildings in the Dong Villages

Figure 11 Dong ethnic festivals and daily social scenes

(1) Orientation

The orientation of a building and the location of its doors reflect the closeness between people and are important factors in social analysis. This article visualizes the orientation and door direction of Dong villages: first, the central points of all buildings are plotted (Figure 12), and then lines are drawn from the building's central points to the direction of the doors. Assign a corresponding color to each line segment according to its vector angle. The direction towards the north is 0°, which is colored blue, and the direction towards the south is 180°, which is colored red (Figure 12, right), so we can get a visual analysis diagram of the building's orientation. This allows us to intuitively observe the orientation relationships between buildings in the entire village, between buildings and the drum tower, and between buildings and rivers, and from this, we can identify the social patterns in the spatial layout of the Dong settlements (Figure 13).

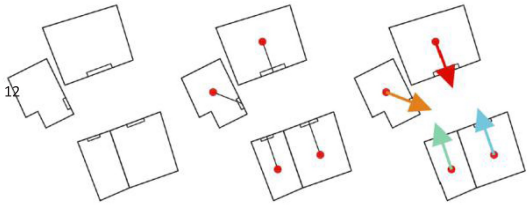


Figure 12 Schematic diagram of building orientation analysis

Figure 13 Analysis of the building orientation in Donglei Village

(2) Distance

From the perspective of quantitative statistics, regardless of whether the village is scattered or clustered, the distance between residences is an important parameter for describing their social relationships. This article conducts a "central distance method"[1] visual analysis of the social distances in Dong villages: First, the central points of all buildings are plotted (Figure 14 left), and then the central points of the buildings are connected. The length of each line connecting a building point to all other building points is calculated (Figure 14 middle). Finally, the shortest line segments between each building point and other building points are selected (Figure 14 right), resulting in a visualized analysis of social factors. The longer the line between building points, the redder the color; conversely, the shorter the line, the bluer the color. This allows us to intuitively observe the distribution of social strengths among the buildings in the entire village. The author drew social analysis maps for the 13 Dong villages surveyed, from which to identify the social patterns in the spatial layout of Dong settlements.

Different natural landforms have a significant impact on the social relationships between houses. Therefore, thisarticle differentiates the social analysis results according to the different landforms, and compares the mountainous Dong villages with the flat land Dong villages (Figures 15 and 16) to explore the similarities and differences in social interaction between the two landforms.

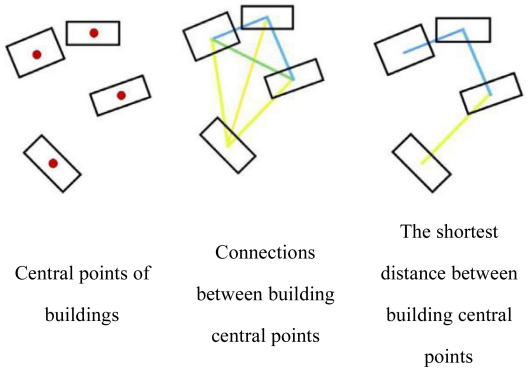


Figure 14 Schematic diagram of building social distance analysis

Figure 15 Social visualization analysis of mountainous settlements

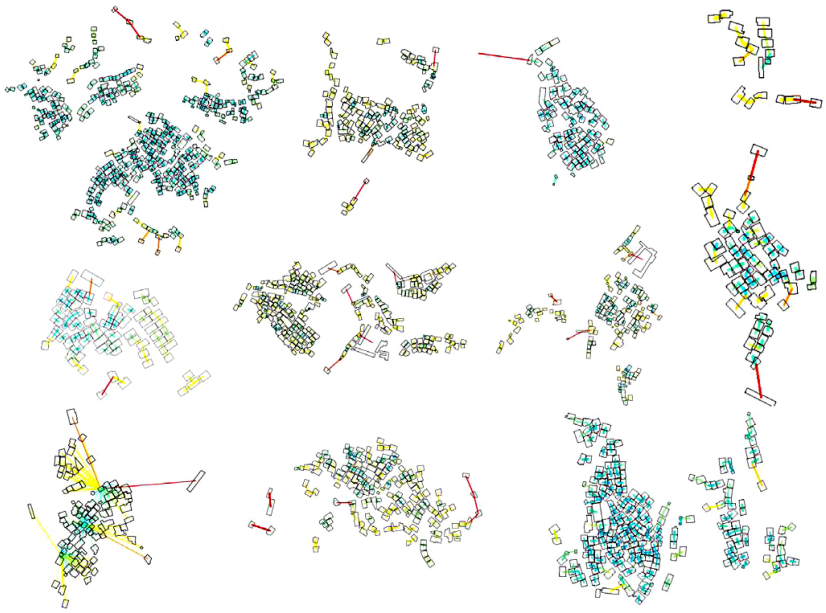


Figure 16 Social visualization analysis of flat land settlements

Typical mountainous settlements have many common features in their bar graphs. Taking the statistical results of Banpo Village as an example (Figure 17), the quantitative results of its social factors reflect and confirm the custom of "living together in clans" of the Dong ethnic group. The social connections within 10-15m of the building are the most numerous, followed by 15-20m. The above social relationships account for 75% of the total. As the distance increases or decreases, the number of buildings shows a sharp downward trend and rarely exceeds 30m.

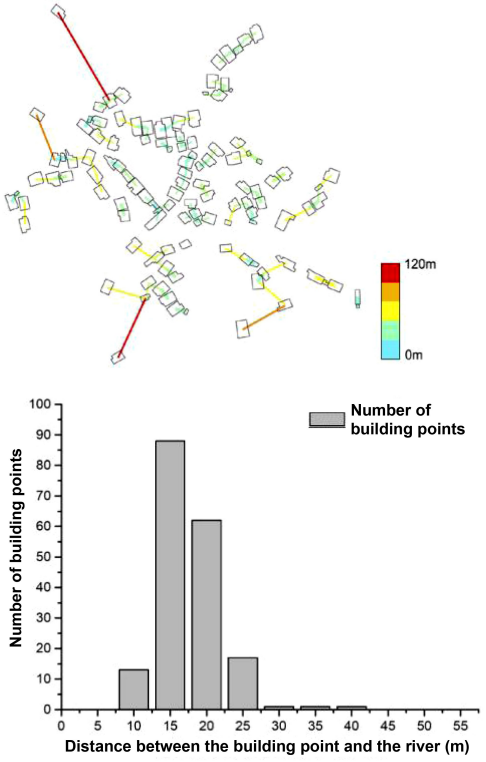


Figure 17 Resultsof social analysis in Banpo Village

By observing typical flat land settlements, we can find the differences between them and mountainous settlements. Taking the statistical results of Donglei Village as an example (Figure 18), it is mainly reflected in the difference in social peak distance: the social distance of mountainous settlements is often slightly larger than that of flat land settlements. The peak value is often between 15 and 20 m. In flat land settlements, social distance is obviously smaller, and social relationships between buildings are closer. The social peak is between 10 and 15m.

We use the nonlinear Gaussian curve fitting method to obtain the distribution curve ofthe housing social factor based on the scatter plot of the relationship between the number of building points and social distance. The social factor of the Dong village can be expressed by the following curve equation through Gaussian nonlinear fitting:

$$y = y0 + (2 \times A/PI) \times (w/(4 \times (x-xc)^2 + w^2))$$

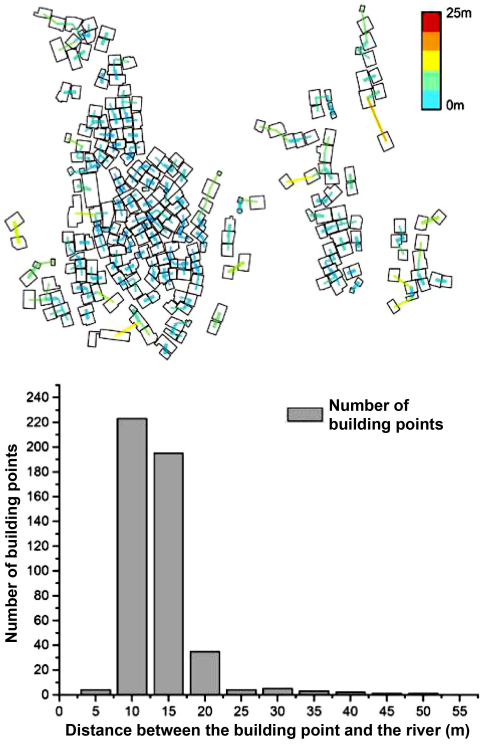


Figure 18 Social analysis results of Donglei Village

The fitting results (Table 7 and Table 8) show the similarity of social customs in Tongdao Dong Village: the curve presents a "wave" shape with a high in the middle and a low at both ends. The trough is between 0 and 5 m. Around 5~ 15m, the social curve rises rapidly and reaches its peak between 15~ 20. It then shows a straight downward trend and reaches a trough at around 30m. Through data visualization, this result vividly reflects the changing pattern of the building layout of Tongdao Dong Village with social distance.

3.4 Research on Kinship Topology

A clan refers to a group of people who are related by blood within five generations. Each Dong village is jointly established by one or more clans, and the drum tower is the symbol of the clan alliance. This article discusses the spatial map relationship within the clans in Yutou Village, a typical mountain settlement, and Gaobu Village, a typical flat land settlement.

Yutou Village is composed of three major clans:

Yang, Long, and Li. The upper village is composed of the Yang and Long clans, the middle village is composed of the Yang and Li clans, and the lower village is composed of the Yang and Li clans. The numbers of households in the three clans are 114, 46, and 32, respectively. In terms of layout rules, the same clans often take the drum tower as the center, attracting each other and forming a whole. Houses of the same clan each form a group, and there is rarely any mixing or intersection between houses of different clans (Figure 199).

Figure 19 Distribution map of the Yang (green), Long (purple), and Li (yellow) clans in Yutou Village

Table 7 Social fitted curve of Banpo Village

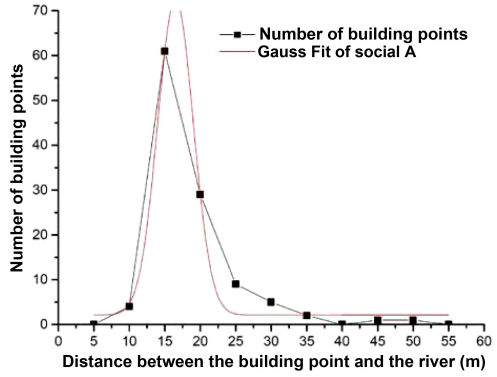
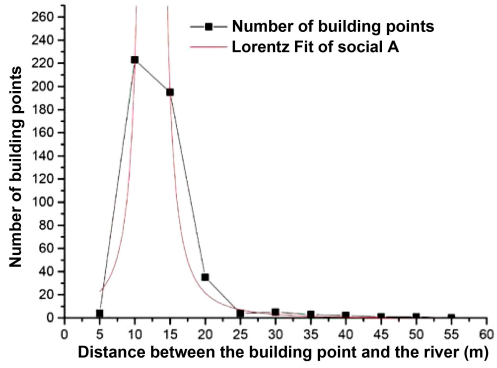


Table 8 Social fitted curve of Donglei Village



Gong Xiangfang[20] studied the distribution of clans in the Dong settlement in Gaobu Village and also yielded similar conclusions. Among them, the houses of the same clans are generally concentrated in the same block. For example, Gaosheng Village in Gaobu Village has four clans, namely yangc bux (Dong language, same as the others), yangc yal, jenl ngox, and jenl xiuv; Longxing Village has two clans, namely jenl liongc and jenl liogx; Gaoping Village is inhabited by jenl ngox and jenl xiuv; Yan Village is originated from jenl xiuv and yangc yal. Yangtian Village is composed of two major clans, jenl xiuv and jenl liogx, while Shangtun Village is composed of jenl ngox and yangc yal.

Judging from the layout analysis diagram, the degree of spatial mixing of family residences in flat land settlements is higher. The Longxing in Gaobu and the two villages in Gaosheng showed a phenomenon of cross-clan cohabitation. However, residences of the same clan are still connected within a local range. In the villages of Yanzhai, Yangtian, and Shangtun, the residences of the same clan are generally arranged in a contiguous layout.

Summary and Outlook

Thisarticle analyzes and draws the spatial genetic map of the traditional Dong settlements in Tongdao County, Hunan Province, visually and quantitatively showing the influence and regularity of traditional region's natural and cultural factors on the growth of settlements. Due to

space limitations, this article only discusses the spatial genetic map extraction and analysis methods of social interaction, hydrophilicity, and clan. However, its methodological system can be applied to the study of a wider range of settlement types and influencing factors.

The quantitative analysis method based on the precise architectural positioning of traditionalsettlements proposed in this article can effectively help us understand and learn the spatial laws and self-organizing wisdom of settlements from the scale of buildings and street spaces, and more effectively protect and inherit traditional regional culture.

In addition, the drawing and statistics of settlement spatial genetic maps have high application value for the organic renewal and expansion planning of traditional settlements, which is an important part of the author's "Simulation of Artificial Intelligence Generation in Traditional Settlements"[21]. The analysis of the natural environment gene map can be used to simulate the site selection of new settlements and the expansion of existing settlements[22]. In addition, the research results based on the social and cultural gene mapping can effectively predict the distribution of settlement buildings and the organic growth process of settlements[23].

In summary, the study of settlement genetic maps has a positive effect on the cultural evolution of settlements and related sociological research. This study provides a valuable research system and method for the establishment of traditional settlements' spatial genetic maps. The significance of the study of settlement spatial genetic mapping lies not only in describing and analyzing the spatial laws of traditional settlements, but also in discovering and understanding the unique spatial composition logic and growth and development mode of traditional settlements. At the same time, it has high application value for settlement planning, design, cultural protection, and revitalization. It is an exploration of protecting and inheriting traditional settlement culture in the current trend of new rural construction and rural planning.

Sources of Figures and tables

Figure 11: http: // mlxc. cnguonong. com/newshtml/16068.html.

Figure 20: Reference[17].

The remaining figures and tables are drawn or photographed by the authors.

Notes

Center distance is away to express the distance between two objects, which refers to the distance between the centers of the two objects. The advantage of this method is that the center distance can be used to represent the distance between different geometric shapes without causing misunderstanding. This method is applicable to buildings with variable widths, profiles and spacing.

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