Open block structure planning of eco city based on big data spatial syntax

Yanming Tang*

Central South University of Technology, Changsha, Hunan, 410000, China
*Corresponding author’s e-mail: tangyanming@axbsk.com

Abstract: For high-frequency sub-images, a hybrid particle swarm optimization algorithm is used to select the threshold, and the neighbourhood algorithm based on average gradient selection is used for fusion. This algorithm can effectively improve the fusion effect of fused images. The experimental research results show that combining the characteristics of gradient intensity and phase consistency, the characteristic method of compressing the information while retaining important information, which is convenient for real-time processing, is used for related research on sensor image fusion. The application of big data to stock planning will help to promote the reform of planning technology and planning subject, and help historical districts better carry out protection planning, construction implementation and operation management. In order to give full play to the urban spatial function, this paper puts forward an ecological city open block structure planning method based on big data spatial syntax. Taking the big data spatial syntax as the core and taking the practical problems as the guidance, this paper constructs the method system and technical realization of the planning, construction and operation management of the historical block supported by the big data spatial syntax, so as to open the block stock of the ecological city. The planning methodology is discussed and innovated.

1. Introduction

In the era of big data, the traditional spatial syntactic computation can modify a large number of data and get more accurate results. The traditional human behavior simulation method is analyzed by overlapping weighting and influencing factors in big data space syntax, and the simulation results are closer to reality[1]. From the multidimensional analysis of time and other aspects, the preliminary research on the relationship between urban form and human behavior is further developed. Based on the analysis of urban block structure, the paper uses big data spatial syntax to modify the moving direction of the mobile crowd and the residence time of characteristic area, so as to obtain " an urban central area". This will greatly promote the urban planning work of mesoscale and suburban design scale. This method can effectively use the big data space syntax in the planning stage to compare, modify and optimize various schemes, and analyze the traffic design and functional layout[2]. Because the shortest path is not the most commonly used optimal path, compared with the shortest path, the big data space syntax algorithm has more movement and function distribution in real space.

On this basis, the hierarchical structure theory of spatial distribution of big data in an urban block network is proposed. Through big data space syntax calculation, the moving path and scope of passenger flow and vehicle flow depend on the shortest path. Therefore, this paper proposes an active path prediction method within the scope of big data space, and generates the best "selectivity" path according to the active path of the prejudgment set[3]. It is because of this feature that big data space...
syntax becomes very different. This method can be used to study the urban renewal of the complex block system and urban texture in the old city, and also can be used to study the mesoscale urban block. For example, from the perspective of the spatial network, spatial network renewal (open block) should optimize the spatial network composed of public space network to play a better social function.

2. Structural planning of open block in eco city

2.1. Function division of ecological city open block based on big data spatial syntax

The theoretical basis of big data spatial syntax is the relationship between space, motion and function. Its structural characteristics are the choice of interpersonal activities, the flow and aggregation of people and vehicles, which determines which function occurs. In the case of a mismatch between spatial structure and function of big data, human activities cannot be satisfactory. In other words, if the spatial structure of an area is attractive and can gather people, then the urban functions and activities that people need can be developed in this area[4]. In big data spatial syntax, common analysis methods include using the urban block network model to calculate the "integration degree", "intersection degree" and "selection degree" of the blocks in the study area. This calculation data reflects the hierarchical structure of the space station in the study area and the direction of the centralized space station (personnel and vehicles) [5]. Due to the high dependence of urban functional activities, especially commercial activities, on the population, big data spatial syntax gradually reveals the relationship between urban spatial structure and functional structure.

Eco city architecture is a comprehensive subject, involving many fields such as economy, society, humanities and so on. Block is an important part of the city, it provides a comfortable, quiet living space, convenient transportation, complete supporting facilities, convenient landscape system[6]. And the current situation in our country is that the closed wall separates the residential area from the city, resulting in the waste of traffic resources. Because of the isolated wall, people can only walk hundreds of meters, even thousands of meters. There is no organic connection between residential block landscape and urban landscape[7]. Some artificial landscapes can only achieve the greening rate and lack vitality. Block architecture is an important part of urban landscape aesthetic system. Compared with most of the rich families in China, the image of the building inside the wall is relatively simple, which reduces people's indifference to public affairs and interpersonal relations.

At present, there are such problems in closed residential blocks in China, which seriously affect the process of urbanization in China. Open block is the need of urban development[8]. At present, the development experience of big data spatial syntax is mature, the population density is appropriate, and the supporting facilities are perfect, forming the urban mode of "urban-rural integration". And in this range, creating an open block type residential block can better reflect the organic integration of residential block and cities[9]. Therefore, the construction of open housing in this area can be fully learnt from the model of urban central area. Sustainable development theory, liveability theory, new urbanism, wisdom growth and other concepts provide a broad theoretical basis for the liveability research of urban residential blocks in China from different fields and perspectives. In this regard, big data spatial syntax is used to optimize the functional facilities of open block in eco city. The specific optimization contents are shown in table 1.

| Strategy            | Concrete measure                                                                 | The main components of habitability                                                                 |
|---------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Land use            | Mixed land use and mixed social strata                                          | Multi functional mixed, walking friendly community, diversified residential forms.                   |
|                     |                                                                                 | Safe, comfortable and efficient transportation system can reduce energy consumption and environmental pollution. |
| Traffic pattern     | Limit car traffic and encourage public transport and non motor vehicle traffic  |                                                                                                     |
| Enhance cohesion    | Provide high-quality public sphere, create historic community culture           | The public sphere that attracts people to walk and increase their                                     |
and ensure community safety communication and activities: community culture and a sense of belonging.

According to the content of Table 1, we can optimize the three aspects of land use, transportation routes and community cohesion, and improve it into a safe and comfortable, energy-saving and low-consumption block with a sense of community cultural belonging.

Different types of land functions are conducive to urban development, but the degree of land mixing is not clear. On the basis of different functions, setting up different types of blocks, such as commerce and services, can enrich the functions of the blocks and enhance the vitality and vitality of the blocks[10]. But the mix of the city centre should be moderate, the premise is that there is a quiet living environment. Urban block is the space that connects the city and micro architecture, and transforms between city and architecture, public and private. The meaning of ecological city open block is shown in Table 2.

### Table 2. The meaning of open block in eco city

| Meaning           | Functional attributes        | Type (classified by national standard) |
|-------------------|------------------------------|----------------------------------------|
| Road              | Traffic function             | Expressway, trunk road and secondary   |
| Street            | Public space function        | Access Rd                              |

Based on the big data space syntax, the open block structure function of ecological city is optimized. The block can choose the network block structure, and the block network density is high. Under the same scale, the higher the block network density is, the smaller the block size is, which meets the block specification requirements of open block housing. Assist in the planning and design of open blocks. According to the big data spatial syntax, the urban block structure types are shown in Table 3.

### Table 3. Classification of urban block structure based on big data spatial syntax

| Type                  | Definition                                                                 | Illustration |
|-----------------------|---------------------------------------------------------------------------|--------------|
| Network road structure| This is a road system that forms a high-density network, with small road spacing and small road width. | ![Network Road Illustration](image) |
| Tree road structure   | The trunk structure is composed of different grades of urban roads, and the lowest level is the local streets (branches) leading directly to the buildings. A number of branches converge into a secondary trunk road, which then transports the converged traffic flow to the main road. The trunk road is a long-distance and large capacity road connecting the urban non network areas. | ![Tree Road Illustration](image) |
| Road structure of "big road" | This is a kind of abnormal urban structure. It is similar to the network structure, but the road density is seriously lower than that of the network road. It is like removing four out of every five roads in the network road, and at the same time, the road width is increased. It is also like a tree structure, but there are no local streets, only secondary trunk roads and main roads. | ![Big Road Illustration](image) |

Open living space refers to the public space that meets the daily life and activities of residents and connects the city. Traditional residential open space refers to the space to meet the needs of residents'
activities. Different from traditional residential open space, it is a closed public space, which has nothing to do with society[11]. The open space of residential block generally divides the large central green space into several Park squares, which are distributed in different positions of each residential block, forming a dynamic open space system. According to its spatial form and function, the open space of residential district can be divided into square open space, green open space and traffic open space[12]. The space syntax of big data is declining, and the development block structure is mainly set up with hard shops, and the greening rate is not more than 50%. It is a comprehensive activity site integrating commercial and public transportation facilities, providing a variety of leisure and communication places for citizens[13]. Green channel is a kind of activity place with plants, water and greening as the elements for people to enjoy and enjoy. The traffic space of urban block refers to the public space such as blocks, pedestrian paths, bus hubs and so on.

2.2. Spatial planning standard of open block based on big data spatial syntax
As the morphological structure and unit of a city, block has certain urban function and landscape characteristics, which is closely related to the evolution and nature of the city. The form of residential block and its relationship with the city vary from time to place, but the core goal of residential block is to provide a quiet, comfortable and convenient living space[14]. At present, the introduction of open block type residential block in China is to adapt to the rapid development of China's new urbanization process, make residential block an organic part of the city, so as to optimize the urban spatial structure and create a suitable living space based on big data spatial syntax.

The relationship between block and city is mainly manifested as: urban block structure, neighborhood shape, neighborhood scale, neighborhood connection, integration of block and urban public facilities, integration of block and urban public space, integration of block and urban public space, and integration of block and urban space. In the construction of modern city, the city is divided into several areas and plays their main role[15]. Therefore, the flow direction of groundwater must be considered and the city center should be divided according to the development of the city. Based on this, big data spatial syntax is used to optimize the mixed hierarchical structure of green city development function, as shown in Figure1.

![Figure1. mixed hierarchical structure of green city open function](image)

In urban layout, block layout can be divided into two types: closed and open. The whole building should take into account three factors. First, the social and economic function of the block, that is, the shaping of the city vitality by the block; Secondly, the visual and physical functions of the block in the urban structure, that is, the intervention of the block on the urban texture and image; thirdly, the function of building bricks on the technical level, including lighting, ventilation, heating, etc. Specifically, the block area should be controlled between 150 meters and 200m, and the vehicle nature
of the contact surface of the block should be clearly defined. The wellhead should clearly distinguish between public activity area and private space. According to the plan, the block is divided and closed, with a large area of street, and more colorful shops can be opened, which will greatly facilitate residents, improve the quality of life and increase employment opportunities.

With the increase of small enterprises in community, large-scale supporting facilities are relatively lacking. First, provide a complete walking system, pay attention to the setting of friendly pedestrian street and commercial street. The door, window and window position at the bottom of the building are coordinated with the surrounding landscape environment except for the public art wall. Windows and windows cannot be ignored. If the interface is too long, appropriate segmentation should be made. Large urban areas usually include a group of homes and some blocks on the ground, which can be reached. The building faces the block, forms the block; the internal courtyard faces back, forming the border of the block. The living environment elements include: block space, space capacity, open space, land layout, road network structure, architectural form and living vitality. Combining with the syntax principle of big data space, the spatial carrier of planning residential block system is improved to judge whether the layout of urban land is reasonable. There are complex interactions and restrictions among many spatial environmental factors such as whether the space capacity of the block is too large, which leads to the decrease of green open space and the loss of vitality of the block, which can improve the overall environmental quality of the community. The design of open community parks can start from several aspects in Table 4.

| Spatial elements       | concrete content                                      | basic feature                                                  |
|------------------------|-------------------------------------------------------|----------------------------------------------------------------|
| Land use layout        | Block function and ecological factor stock           | Ecological and functional mixed, flexible reserved land         |
| Road network structure | Dimension plane scale and street avoidance density    | Small scale, small-scale flexible layout, elastic strain        |
| Street space           | The ratio of street height to width (d) and the density of street interface | The density of D / HK1 Living; Street is generally large         |
| Space capacity         | Block size, plot ratio, population, per capita living area | S The public space is large, accessible, well-equipped and attractive |
| Open space             | Whether the rate of green space, the suitability of space pterygium and the use meet people's needs | Plot ratio < 10, local breakthrough                             |
| Architectural form     | Flat form, density and height of buildings            | The rate of green space is high                                 |
| Block vitality         | Rules, accessibility, culture and attraction of public space | There are many enclosed types with moderate range and high-rise buildings |

In order to achieve the effect of planning and design and improve the speed of planning and design, in the process of structural planning, open block landscape planning should pay attention to the relationship with the city, and follow the principles of openness, leisure and ecology. Pay attention to the construction of street view, create block squares and create block landscape. The implementation of the existing open block, pay attention to the separation of people and vehicles, and build the public landscape of walking and Jingcheng city.

2.3. Perfect structural performance of open block in ecological city
Open block is a part of urban space and function. It not only emphasizes the connection with the city interior, but also emphasizes the independence of form and function, so as to realize the socialized opening of block structure and supporting facilities. It is embodied in: communication of urban traffic organization, reasonable road network density, sharing of supporting facilities and landscape resources, friendly and open block interface, and harmonious, quiet and dynamic city life. Through the analysis
of the open block at home and abroad, the common features of open block design are summarized into
two dimensions: qualitative analysis and quantitative analysis. The qualitative indicators of open block
summarize the mixing of various architectural functions in the block, the diversity of architectural
forms, the rich and logical appearance, the slowly moving green space in the open block, and the
integration of vertical functions of single building public space with the orderly state. Summary of
quantitative indicators of open space area: open space area < 200m × 200m; open space area ≥ 15%;
open space density 55% - 70%; space spacing less than 5m; open space area less than 60%; motor
vehicle parking space no more than 30% of the open space area. Compared with the large central
landscape of traditional residential blocks, the public space of open residential blocks is generally
smaller and more scattered.

At the same time, different levels of public space can accommodate more activities. According to
the different degrees of openness, public space can be divided into "public semi public and semi
private". According to the spatial scale, the public space of open block can be divided into three levels:
regional level, block level and block level; from the perspective of different space forms, it can be
divided into node space, linear space and plane space, which together constitute the diversity level
characteristics of public space types in open block, which are shown in Table 5 and Table 6.

Table 5. various types of playing in public space and their levels

| Public space type | District and city level | Residential level | Neighborhood level |
|-------------------|------------------------|-------------------|--------------------|
| Plane space       | City Park Plaza        | Commercial Plaza  | --                 |
|                   |                        | Cultural Square   |                    |
| Linear space      | Water green space      | Life street        | --                 |
|                   |                        | Street Square     | Sports, Jianwu venue |
|                   |                        | Street green space| wants to stay      |
| Node space        | --                     | Street Square     | --                 |
|                   |                        | Street green space|                    |
| Public space      | Public                 | Semi public       | Semi private      |
| hierarchy         |                        |                   |                    |

Table 6. division of ownership of various spaces in open blocks

| Block space layer | ownership                  | Construction management right               | Usufruct                      |
|-------------------|----------------------------|---------------------------------------------|-------------------------------|
| Public            | Government                 | Government Developers                       | Developers                    |
| Semi public       | --                         | Community Management Committee             | Developers                    |
|                   |                           | Self organization of residents              |                               |
| Semi private      | --                         | Association                                 | Self organization of residents |
|                   |                           | Residents' self governing organizations     |                               |
|                   |                           | Community Management                        |                               |
| Private           | --                         | Committee                                   | Self organization of residents |

The users of the public space living in the open block are not only the users of the block but also
other residents. For activities, needs and behavior patterns are different. Personal activities such as
walking and talking need a quiet and friendly place; sports, entertainment and leisure activities need a
spacious and safe place; temporary and personalized activities, such as offline social networking, need
convenient transportation and a good environment. The spatial form of open community public space
has the characteristics of hierarchy and diversity, which is the material basis for different groups to
share public space.
There is a positive externality in the public sphere, that is, the personal income of the developers (usually the government) is lower than that of society or other people, and does not recover more profits, but flows to the city to benefit the public. But in the long run, investors will be in a state of no return. Through the policy incentive model, the government and the community management committee will transform the positive externality into the construction management right, which will directly benefit the developers and residents. Developers and neighborhood committees can obtain certain economic benefits through direct income, commercial return and value-added operation, while government and community management can obtain the greatest social, environmental and cultural benefits. Based on this, the structure and function of open blocks in eco city are further standardized, as shown in Figure 2.

Figure 2. evaluation path of planning implementation effect based on big data

As the creator of space sharing platform, the primary task of planning department and community is to establish open space resource database. Secondly, the potential supply-demand relationship of public space in the community is investigated, and the potential supply-demand relationship is preliminarily classified to form the basic database of supply resources itself; secondly, the sharing of traffic space is the best embodiment of open community space sharing; thirdly, the construction of open community advocates the community to return to the people-oriented scale, especially the living blocks in the community moderate and walkable.

We will promote the construction of people and vehicles sharing transportation space and improve transportation facilities. Based on the POI data of Baidu and Dianping, combined with the block network and land use status, this paper studies and analyzes the commercial types of historical blocks. By calculating the proportion of commercial formats in POI, the matching degree between the functional composition of existing blocks and the planning objectives of each district is evaluated, and the functional orientation and transformation direction of each district block are clarified, as shown in Figure 3.
Figure 3. Optimization of the structure planning module of eco city development block

According to the POI statistical data, this paper evaluates the spatial distribution and utilization of community and urban commerce in Hengfu area, so as to improve the coverage rate of community business services and the attractiveness of urban commercial services. New technologies such as the Internet of things and big data are used to optimize the opening of commercial formats in communities and cities and the fine management and protection of spatial distribution. This paper studies the establishment of multi-level dynamic monitoring and visual operation monitoring management system in the demonstration area to realize the refinement and intelligence of regional operation monitoring management. It provides new ideas and methods to solve the problems of daily operation and management of the old city, which will effectively promote the planning, construction and management of historical blocks to the fine, dynamic and scientific direction. Urban block planning combined with big data spatial syntax can effectively shorten the planning preparation, implementation and update cycle.

3. Analysis of experimental results

Using the basic data of urban geographic information, this paper analyzes the block size, block density and land use composition, and completes the preliminary judgment of open block. Uses mobile communication signal data to determine the population activity area, and quantitatively discusses the relationship between the population activity area and the open block. Uses the existing urban structure data to determine the block building density in line with the building scale and control requirements.
According to the data of urban interest points, identify and analyze the convenience of blocks (applicable to each block). Use public opinion big data to identify and analyze the hot spots of open blocks. Based on the basic data of urban geographic information, the basic attributes of blocks are identified and analyzed.

Five core regions are selected for spatial correction and geographic registration to realize the matching of block network, fence and electronic map. By understanding the concept of block (i.e. four blocks or other areas surrounded by physical space), the five core areas enclosed by block network are transformed into regional units based on ArcGIS software. The density grade of road network and land use structure of each core area are analysed ArcGIS software, using mobile communication signal data, makes statistical analysis on the dynamic value and geographical space of the old city. Removes the dynamic value of unit area per unit time of scenic spots and commercial areas through the visualization of thermal map. Obtains the dynamic value of unit area per unit time in unit time through the division of dynamic value of unit area per unit time in unit time So as to realize the quantitative comparative analysis of unit area per unit time in the old urban area. The details are shown in Figure 4.

![Figure 4. Spatial structure of eco city](image)

Based on this further research, in order to verify the simulation effect of urban micro public space layout form planning, the experimental comparative detection is carried out. Firstly, a city is selected randomly, and the basic information of the area is integrated. The specific information is shown in Table 7 and Table 8.

| System | Category | Measure of Area | Public Satisfaction % |
|--------|----------|----------------|-----------------------|
| Human space | Living space | 284.1 | 65 |
| | Living space production space | 203.4 | 52 |
| Green space | Public land | 964.2 | 60 |
| Grey space | traffic | 1085.0 | 62 |
| | Architecture | 1023.5 | 64 |
| | Open space | 1002.8 | 63 |
| Space function | Administrative area | 783.9 | 66 |
| | Economic Region | 987.6 | 67 |

| System | Category | Measure of Area | Public Satisfaction % |
|--------|----------|----------------|-----------------------|
| Human space | Living space | 398.1 | 87 |
| | Living space production space | 236.8 | 85 |
| Green space | Public land | 1132.4 | 84 |
| Grey space | traffic | 1674.5 | 84 |
| | Architecture | 1640.8 | 82 |
| | Open space | 1642.8 | 88 |
| Space function | Administrative area | 1006.6 | 86 |
| | Economic Region | 1205.4 | 84 |
Based on the above comparative survey results, compared with the traditional urban open block planning method, the public satisfaction of the ecological city open block structure planning method based on big data spatial syntax is relatively higher, and the regional planning is relatively more reasonable, which fully meets the research requirements. The results show that there is a certain correlation between the traffic flow of each station, the road network structure around the network and the number of diners. The actual central layer of each station is analyzed to further verify the matching degree between the center layer of each station and the station network. The research is to use spatial syntax to reflect the influence of different street texture on the choice degree of pedestrians and vehicles in residential blocks from the side, and also reflect the convenience of pedestrians and vehicles in the moving. The big data analysis method is introduced into the field survey to provide data support for the selection of investigation cases and the determination of characteristics, which reflects the rigor and science of the research.

4. Conclusion
It is an important condition for the sustainable development of city and residential space to endow the city with vitality and make the urban residential space return to the city. Open building areas are not simply "demolishing walls." Clear urban space system, social awareness of respecting property rights, and perfect relevant laws and regulations are the substitutes and preconditions for the tangible boundary of "breaking down walls and penetrating green". Based on this, combining with the space syntax principle of big data, this paper optimizes the spatial structure planning method of open block in green City, realizes property right conversion through network technology, and improves the utilization of open space resources in blocks Rate.

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