Living Space Research in Typical Residential Areas of Shanghai

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Abstract： Under the background of market transformation and rapid urbanization, the differentiation of social stratum and living space is becoming more and more obvious in China. The complex background and multiple patterns of residential areas have shaped a variety of living space, which can reflect different life styles and qualities. This article takes Shanghai as an example. It takes advantage of mobile phone signaling data on large sample of residential scale, compares and analyzes the spatial characteristics of living activities in various residential areas, and explores the scope, structure, rules and influencing factors of living activities from the overall level of the city. The study summarizes the living space of typical residential areas in Shanghai into four typical patterns: single center, strip, multi-center and tadpole-shaped. At the same time, from the perspective of the life circle, we will further evaluate the community construction in Shanghai and propose planning guidance. Combining small data such as questionnaires to make up the shortages of mobile phone signaling data and to further the study of living space from the micro level. Further, by combining mobile phone signaling data and questionnaires, the article tries to evaluate the quality of the living space, and applies the results to the evaluation of the community life circle and planning guidance.

Key words: living space, typical patterns, community construction, mobile phone signaling data

0.Introduction

China is in the period of comprehensive economic and social development. Urban development has shifted from scale growth to focus on the improvement of connotation quality. From the perspective of treating residents as homogeneous and diversified to paying attention to the diverse needs of different groups, we have begun to pay attention to urban life in addition to focusing on production. The construction of space and the improvement of the quality of life of residents.

The residents' weekend activity space has a high matching relationship with the urban living space, and the weekend activity behavior becomes an important perspective to see the urban spatial structure. As a relatively homogeneous internal entity, the residential area has a specific built environment, resident attributes and housing attributes, and has become an important unit in the analysis of weekend activity behavior. This paper analyzes the spatial pattern of weekend activities in different residential areas, and explores the boundary, characteristics and spatial distribution patterns of activities. To a certain extent, it can reflect the characteristics of urban living space, the level of construction, existing problems, and the development of urban tertiary industry and living space. The formulation of policies such as transportation facilities has practical significance.

1.Research review

In the traditional group behavior study, the data of residents' daily activity behaviors are mostly based on the questionnaire survey and activity log method (Zhang Ping, Yang Dongyuan, 2012). The questionnaire data obtained has rich individual attribute information and can be used for different attributes. The crowd conducts detailed and in-depth analysis and discussion; but because of the small sample size, the contingency due to sample selection is highly likely to influence the final research results.

With the advent of the information age, mobile positioning technology has been continuously developed and widely used, and the use of new technologies to study the daily activities of residents has become more and more common. At present, domestic research on residents' activity behavior is mainly based on GPS data, microblogging sign-in data and multi-data comprehensive application. GPS data is often combined with civic activity logs for analysis. Chai Yanwei (2012) studies urban life circle planning in Beijing based on time-space behavior. Shen Yue (2013) conducts daily activities for residents of giant communities in the suburbs of Beijing. In the study, Tana (2015) conducted a study on the behavioral measures of the daily life of residents in the suburbs of Beijing and the relationship between space and behavioral activities. Wang Bo (2014, 2015) used Sina Weibo to check the data to study the spatial characteristics of Nanjing urban activities. Liu Zhongjun (2017) used the multi-data of Gaode POI, Sina Weibo to sign the data, and the public comment merchant data to study the urban activity space in Zhangzhou.

Mobile phone data has the characteristics of high coverage and high holding rate. Its large sample size and rich individual spatiotemporal behavior information provide a new opportunity for residents' weekend activities and urban space research. The existing research in China focuses on the discussion of commuting behavior, occupational and residential relations, and little research on the activity space.

Cell phone data has achieved a breakthrough in sample size, but there are few studies on weekend activity and space in China. This paper uses the mobile phone signaling data to use the residential area as the analysis unit to generate the activity “small data” at the residential level through the individual weekend activity “Big Data” to identify the spatial distribution pattern of weekend activities of residents in different residential areas in Shanghai, and summarize the characteristics.

2.Research objects, data and technical routes

2.1 Selection of residential area samples

Shanghai residential areas are widely distributed from the central city to the surrounding areas. The housing types cover shanty towns, workers' new villages, general commercial houses, villas, and affordable housing. The traffic and living facilities in different residential areas vary greatly.

The sample is based on the representativeness of the residential area and the reliability of mobile phone data. The residential area with an area of more than 1km2 and internal and surrounding is selected to ensure a certain scale and uniformity. The identification of the largest base station point is recorded by the internal data of the

residential area. As a resident of the community, the resident population must have a value greater than 300 to ensure the reliability of the data. On this basis, considering geographical differences, housing types, and rail transit convenience, 253 residential districts were selected within the Shanghai area, which is consistent with the type and quantity distribution of residential areas in Shanghai (Figure 1).

Figure 1 Distribution of sample points in 253 residential areas in Shanghai

2.2 Data Processing

2.2.1 Raw data

The research mainly uses the mobile phone signaling data of Shanghai 2G mobile users in the first half of 2014 in the first half of 2014. The Shanghai area records an average of 16 million to 18 million different mobile phone identification numbers per day, and the average daily signaling record is about 600-800 million. There are tens of thousands of base stations distributed in the city. The distance between base stations ranges from several hundred meters to several kilometers. The base stations in the central city are dense. Each piece of signaling data includes information such as user ID, time, base station location number, and event type (such as answering a call, sending a text message, and updating a location).

2.2.2 Residential area identification

Each mobile phone signaling data records the number of the user contacting the base station, and when performing location identification, the base station location is used to estimate the actual location of the user. In the study, for each record point of each user from 20 days to 6 o'clock in the next day, remove the remote point, select the point with the smallest average distance from all points as the residence of the day, and repeat the operation to get 14 days of possible residence. A set of locations, using the above distance and minimum method to select a stable place of residence. The data identified a total of about 13.71 million users with stable residences. The sample size is about 57% of the resident population of Shanghai Liupu. The Pearson correlation coefficient between the street level and the Liupu permanent population data is 0.910, and is at 0.01 level. Significantly related, it is feasible to describe the method of mobile phone data to identify the resident population.

2.2.3 Activity stop identification

Clean the mobile phone signaling data, kick out the remote point, and calculate the time interval (the first point and the last point) of the user continuously in the same place. If it exceeds 20 minutes, it will be regarded as a stop; in practice In use, the active place to stay must be removed from the place of residence.

2.2.4 Data selection

This study is aimed at weekend activities, using a standard weekend consisting of four days of data from Saturday and Sunday in a two-week Shanghai mobile phone signaling data in 2014 to reduce the chance of a single weekend.

2.3 Technical route

Based on the selection of residential areas, the average activity direction, travel distance, and number of trips of 253 sample weekend activity spaces are described as a whole; through the weekend, the nuclear density distribution map of the residential area, the travel distance frequency distribution map, and the time-lapse travel time and other visualization methods. Comprehensively judge and identify the distribution pattern of weekend activity space, summarize the characteristics of various modes, and analyze the activity circle of each residential area to further supplement the model features.

3. Overall situation of the event space

3.1 Average travel directions

The average travel direction refers to the connection between the coordinates of the place of residence and the average coordinates of the active place of residence, and the degree of deviation is characterized. According to the analysis results (Fig. 2), the weekend activities have a consistent directionality, pointing to the direction of the city center; from the travel offset distance, the offset of the central city is the smallest, and as the distance from the central city increases, The offset distance also increases, and when it arrives in the suburb of New Town, there is a significant shift in the offset distance.

3.2 Average travel distance

The average travel distance is the average of the distance traveled by residents of the residential area during weekend trips (Figure 3). There is a case where the distance from the central city becomes larger and the average travel distance increases, until the new city has a more obvious fall.

3.3 Average number of trips

The average number of trips in the sample ranged from 3 to 8 and there was a large difference (Figure 4). The number of trips by Pudong residents is significantly lower than that of Puxi residents. As the distance from the central city increases, the average number of trips increases.

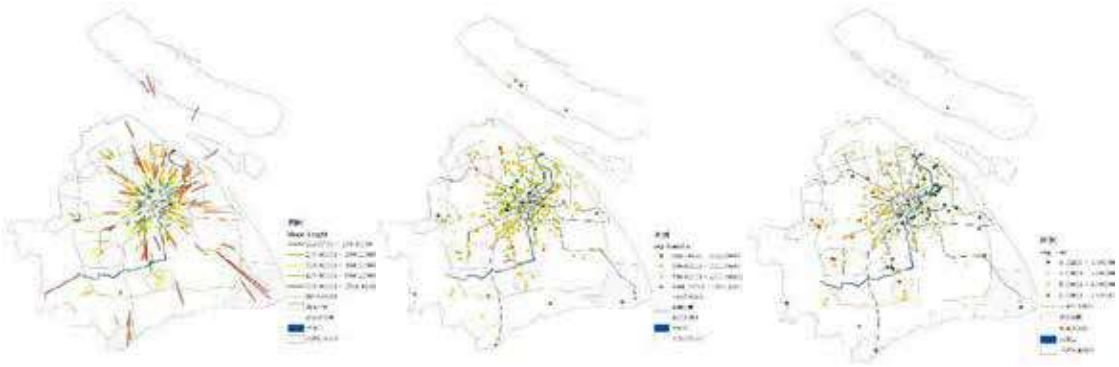

Figure 2.3.4 Average travel direction, average travel distance, and average travel time of residential samples

4. Spatial distribution pattern recognition

4.1 Pattern classification

Through data processing, based on the characteristics of the weekend activity nuclear density distribution map, the travel distance frequency distribution map, and the time-separated travel time of each of the 253 sample residential areas, the weekend activity space of residents in Shanghai residential areas can be divided into four modes. Class (Figure 5): single center, strip, tadpole, multi-center; according to the internal differences of each category, it can be further divided into 7 sub-categories (Figure 6).

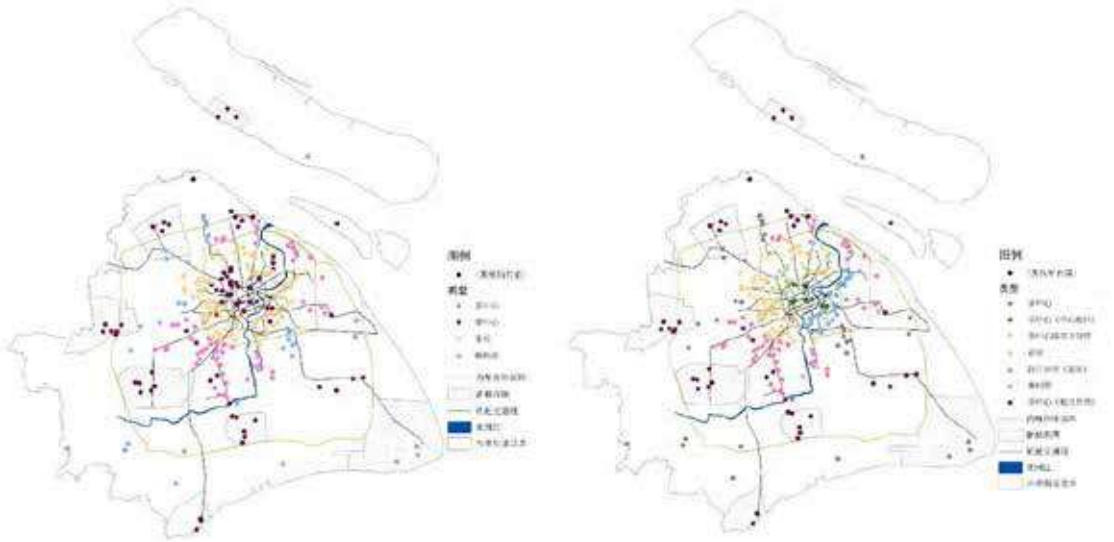

Figure 5.6 Residential area sample pattern classification

4.2 Characteristics of each mode

4.2.1 Single center

The common characteristics of the single-center mode samples are: single-point agglomeration of the active space distribution, the travel distance probability distribution decays very fast, the activity ratio is extremely high within 2km, and the average travel distance is relatively short. It can be divided into three sub-categories according to form and location (Fig. 7): single center (inside inner ring), single center slightly directional, single center (urban periphery), a total of 74, accounting for 29.2% of the total number of samples.

(1) Single center (inside the inner ring)

The samples are concentrated in the inner ring. The built environment of the inner ring is high in maturity, the living space is relatively well constructed, the service level of various public service facilities is high, and the accessibility is high, which can satisfy most living and leisure needs. Possible causes of distribution. The average travel distance is less than 5km, and the relative peak of travel is ushered in at 10:00-11:00 and 14:00-15:00 on weekends. The overall "m" type is relatively flat (Figure 8).

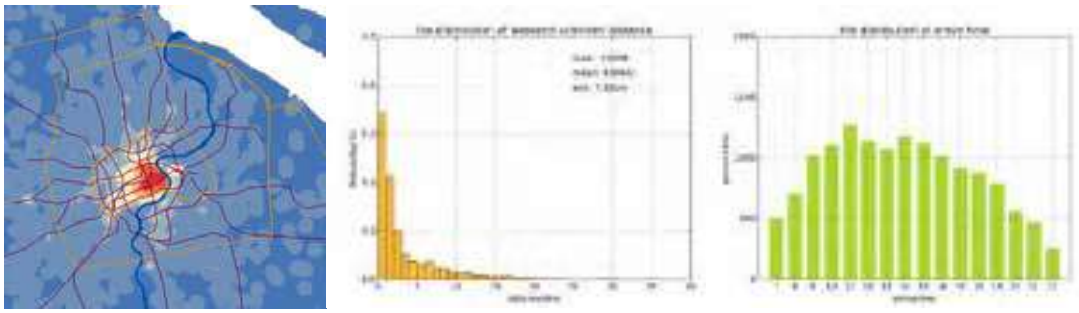

Figure 8 Single center (inside the inner ring) [Sanqingli] Nuclear density distribution, frequency distribution of travel distance, travel time distribution

(2) Single center is slightly directional

This mode is mainly distributed in the periphery of a single center (inside the inner ring), and can be further divided into two categories according to the degree of agglomeration (Fig. 9). The higher the degree of agglomeration, except for the directionality of the activity space, is very small compared with the single center (inside the inner ring) (Fig. 10); the lower the degree of agglomeration is concentrated in the northwest direction between the inner ring and the outer ring, presenting the group Blocky, located between the single center (inside the inner ring) and the degree of agglomeration (high), the surrounding environment is not mature enough to cause the difference, the travel distance attenuation is relatively slow, and the average travel distance is between 5-7km (Figure 11).

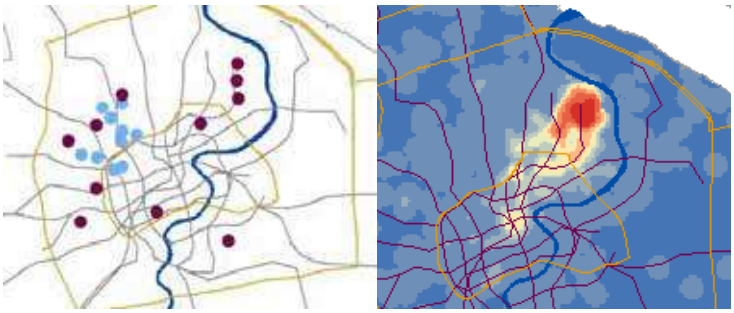

Figure 9.10 Single center slightly directional (sub-category), single center slightly directional (high) [Shiguang Xincun] nuclear density distribution

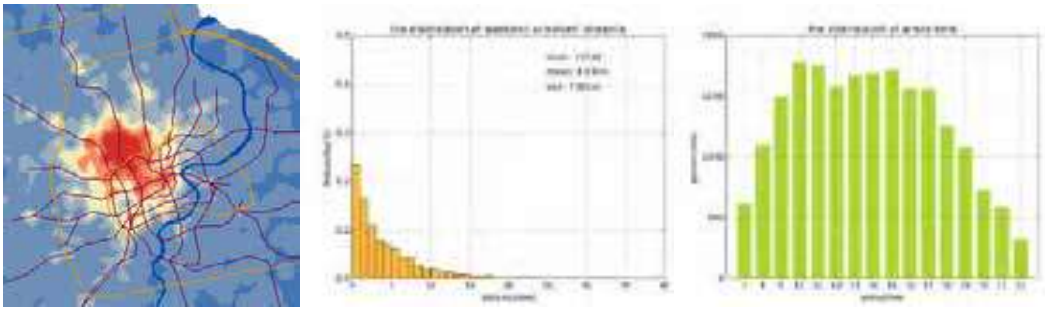

Figure 11 Single center slightly directional (low) [Ganquan community] nuclear density distribution, travel distance from home, frequency distribution, travel time distribution

(3) Single center (outside the city)

Most of the samples are distributed in the new suburbs of the suburbs. The built-up environment in the new city has a high maturity and can meet most of the living needs. The urban peripheral areas outside the new city have low maturity. If residents give up the service facilities in the new city, they will have to pay. Large distances and time costs go to the central city. Obviously, the necessity of doing so is low, so most of the new towns have a single-center model. The average travel distance is farther than the single-center mode of the central city. Within 10km, the relative peak of travel at 10:00 and 17:00 on weekends is more polarized than the travel time in the central city.

4.2.2 Ribbon

The common characteristics of the strip pattern samples are: the sample is concentrated between the inner ring and the outer ring, and the central area is surrounded by the single center mode. The activity space distribution extends to the center of the city. The travel distance probability distribution is relatively gentle, and the activity within 2 km is active. It is relatively high and the average travel distance is medium. It is divided into two sub-categories by the Huangpu River (Figure 12), a total of 90, accounting for 35.6% of the total number of samples.

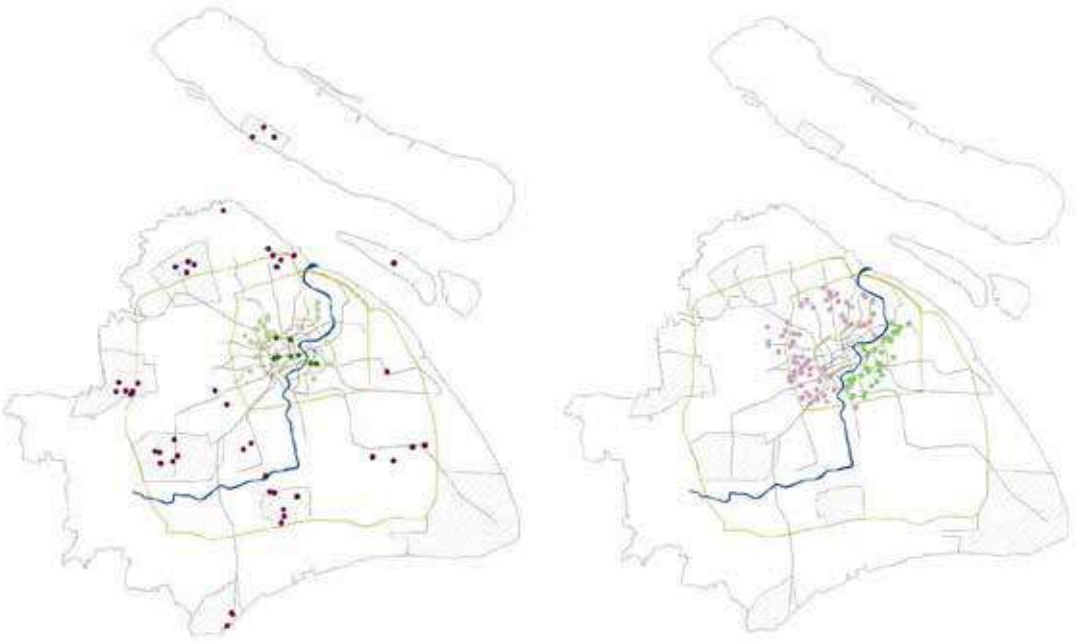

Figure 12 Single Center (Subclass), Band (Subclass) Mode Distribution

(1) Ribbon (Puxi)

This mode ushers in the relative peak of travel at 10:00 and 14:00-15:00 on weekends, and the overall “m” type with a flatter upper end. It can be further divided into two categories according to the degree of agglomeration (Fig. 13). The higher the degree of agglomeration is close to the single-center mode of the central city, the average travel distance is 5-7km (Fig. 14); the lower the degree of accumulation is close to the outer side of the band with a high degree of aggregation, the distance attenuation is more gradual, and the average travel distance is 5-10km (Figure 15).

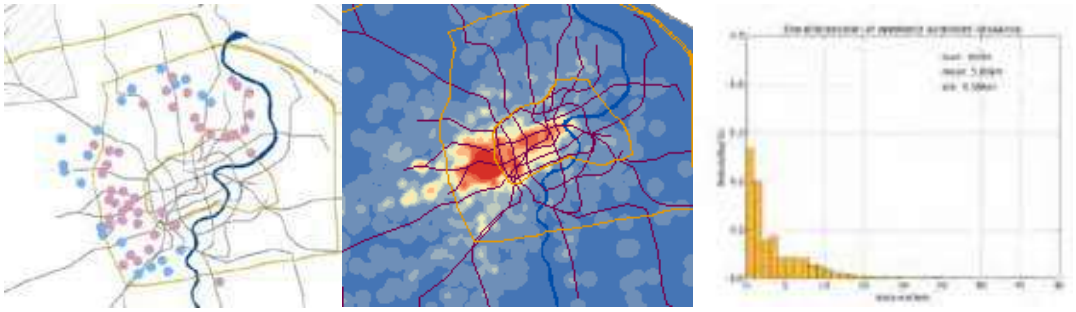

Figure 13.14 Band (Puxi) [subclass], banded Puxi (high) [Gubei District] nuclear density distribution, travel distance from home

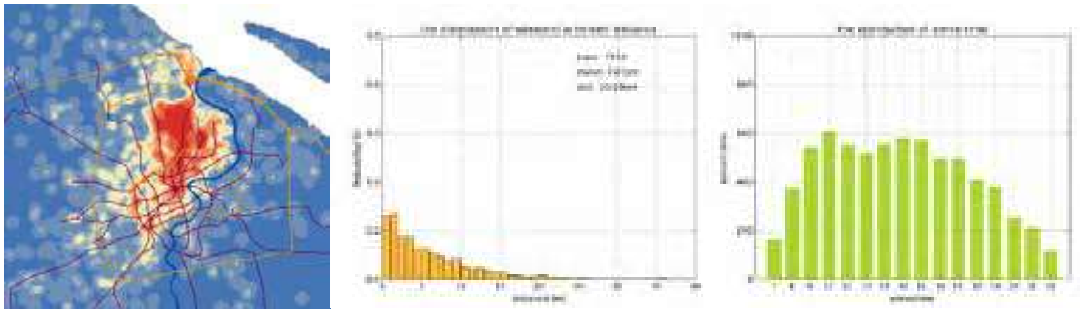

Figure 15 Band-shaped Puxi (low) [gaojing district] nuclear density distribution, frequency of travel distance, travel time distribution

(2) Ribbon (Pudong)

The scope of this model activities spans the Huangpu River. The attraction in the central area of Puxi is large enough. The Pudong construction is relatively immature compared to Puxi, which is the possible cause of its distribution. The average travel distance is 5-7km. The relative peak of travel at 10:00, 14:00-15:00 and 17:00 on weekends (Figure 16).

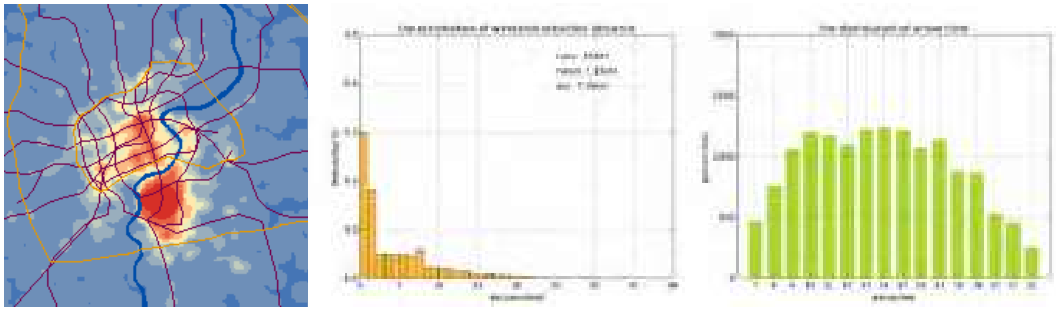

Figure 16 Band (Pudong) [Dezhou New Village] nuclear density distribution, travel distance from home, frequency distribution, travel time distribution

(3) Influence of Huangpu River on strip mode

A comparison of the belt patterns in Puxi and Pudong (Fig. 17) found that residents in residential areas in Puxi rarely travel to Pudong on weekends, and there is a clear dividing line along the Huangpu River. A large number of residents in Pudong's residential areas will travel to Puxi. .

This is directly related to the urban development process of Pudong Puxi. The old city of Shanghai is concentrated in the Puxi area. After years of development and internal self-coordination, the maturity is quite high and can meet the needs of life to a great extent. Pudong was in the 1990s. Great development, production space first, living space construction is relatively lagging, richness, grade, quality, quantity and Puxi gap.

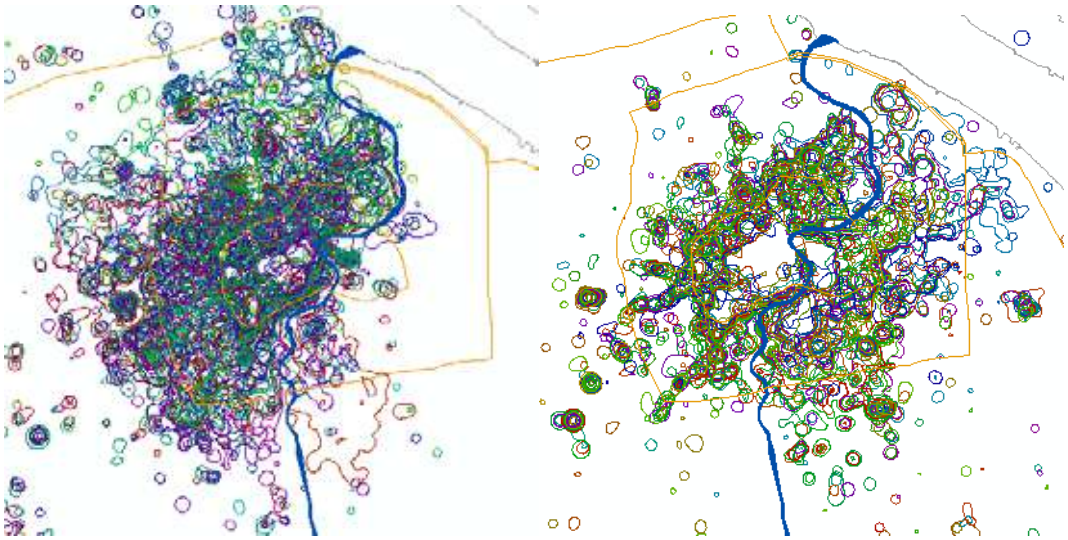

Figure 17 Band mode active boundary Puxi (left), Pudong (right)

4.2.3 tadpole shape

The sample of the tadpole shape is concentrated on the outer side of the outer ring and along the area of the rail transit, showing the morphological characteristics of the single core-long tail. The community built environment has a certain maturity, the service level of public service facilities is general, and the transportation along the rail transit is convenient, which leads to a sharp increase in the demand and possibility of activities in the areas along the line. This is a possible reason for the formation of this form.

The activity ratio is the highest in the range of 5km, and the distance attenuation is very gentle after 5km, and there is basically no ups and downs. The average travel distance is between 5km and 10km.

The relative peak of travel is ushered in at 10:00, 14:00-15:00 and 17:00 on weekends (Figure 18).

56 samples of the skull pattern, accounting for 22.1%

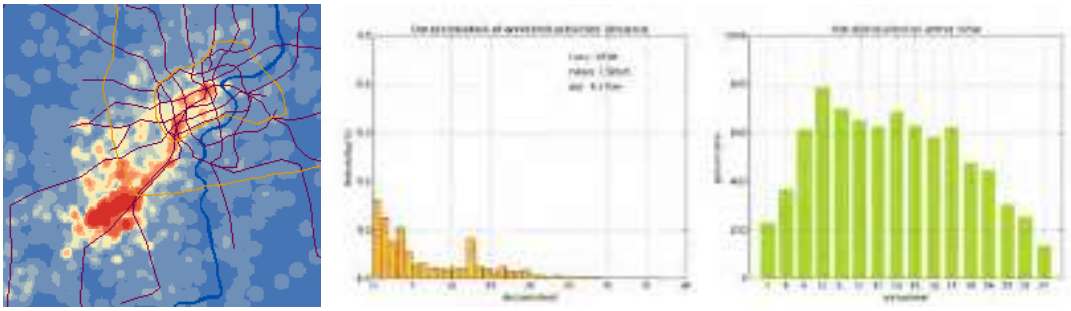

Figure 18 tadpole shape [Oasis Xiangdao Garden] nuclear density distribution, frequency of travel distance, travel time distribution

4.2.4 Multi-center

The sample is distributed outside the outer ring, between the main city and the new city (Figure 19). The residential area has a low maturity environment and a poor service level of public service facilities. The competition between the new city and the service area of the central city and the residential area is attractive, which makes the activity space of the residents appear multi-centered.

The activity ratio is the highest in the range of 5km, and the distance attenuation is relatively flat after 5km. There are several small peaks and the average travel distance is more than 7km. The relative peak of travel is ushered in at 10:00 and 16:00-18:00 on weekends.

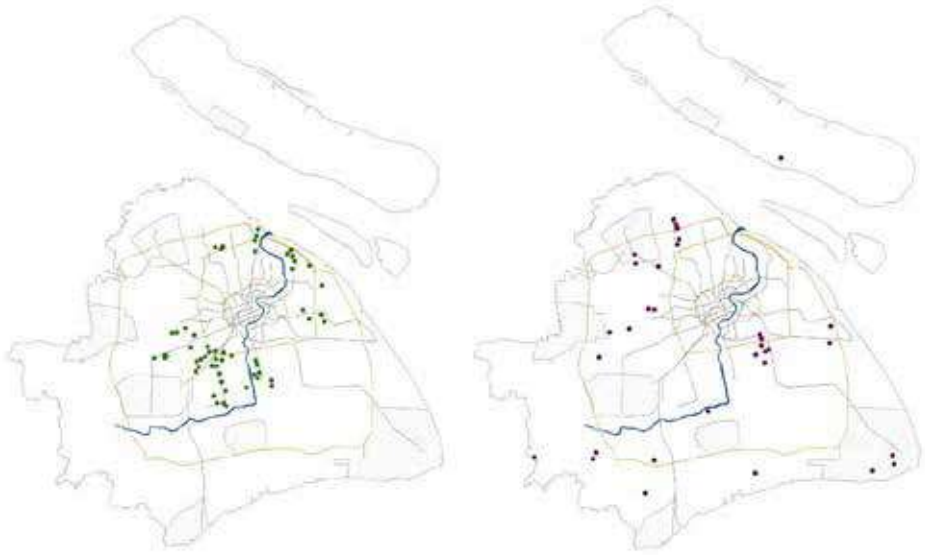

Figure 19 tadpole, multi-center mode distribution

There were 33 multi-center model samples, accounting for 13%. According to the traffic location conditions, it can be divided into two categories. If the traffic environment is poor, there is no rail transit within 3km. The performance of the weekend activity space is closely related to the new city. The samples with such characteristics are mainly distributed south of the northwest-south line of Shanghai (Figure 20).

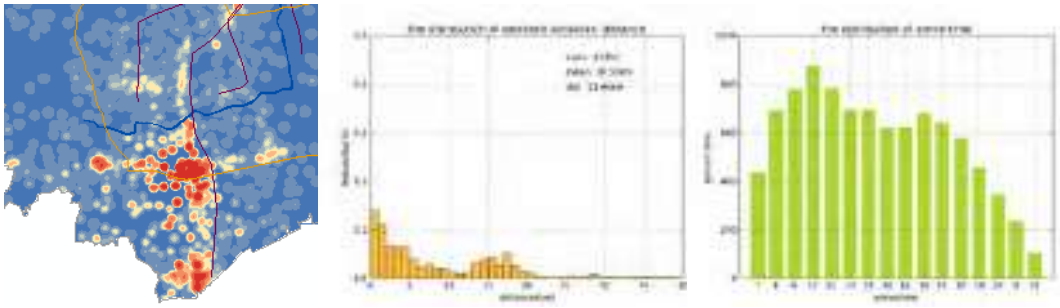

Figure 20 Multi-center (poor traffic) [Tinglin New Village] Nuclear density distribution, frequency of travel distance, travel time distribution

If the traffic conditions are good, there is rail transit within 1.5km, which is more closely related to the main city. This type is mainly distributed north of the northwest-south line of Shanghai. The influence factors of different regions are different, and the shape of multi-center is also different. When the density of rail transit is large and affected by multiple rail transits, it presents a “multi-center + multi-band” pattern; When the degree is not enough, it shows a pattern of scattered across the river; when it is not affected by the maturity of the new city's built environment, it presents a multi-center form of “new city + central city” (Figure 21).

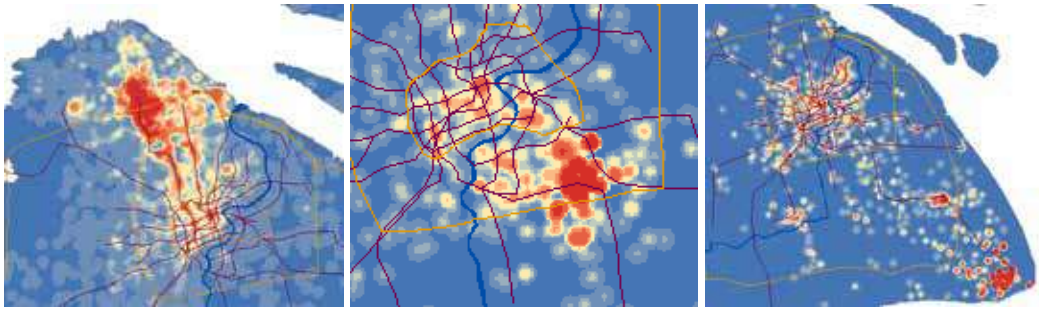

Figure 21 Multi-center (good traffic) [Ronan New Village], [Kangqiao Baoyu], [Yihao Jiayuan] nuclear density distribution

4.2.5 Summary of mode features

The models and their related characteristics and influencing factors are summarized and summarized . There is a certain circle relationship in the distribution of weekend activity space patterns. The number of travels in different time periods increases from 10:00-11:00 and 14:00-15:00 to 10:00, 14 as the distance between residential areas and urban centers increases. :00-15:00, 17:00, and finally to 10:00, 17:00, that is, the residents living on the edge of the city on weekends travel early in the morning, later in the evening. At the same time, the average travel distance also increases with the distance from the city center. The frequency of travel distance from home is roughly slowed down with the increase of distance from the city center. There are several small peaks in the sample outside the outer ring, between the central city and the new city.

For each mode, the main influencing factors are the location, the maturity of the surrounding communities, the facility convenience, and the rail transit conditions.

Summary

This paper uses mobile phone signaling data to identify, classify and characterize the weekend activity space patterns of residents in 253 typical residential areas in Shanghai. It describes the non-commuter travel characteristics of residents and explains Shanghai to some extent. The level of urban living space in the city.

However, there are still many deficiencies in this study. The internal spatial structure and model causes of each model have not been further explained. The relationship between housing type, location, service facilities, traffic conditions and weekend activities is not enough to explain the lack of quantitative support. The general pattern of the association between housing type and activity space.

At the same time, due to the lack of personal attributes and the judgment conditions of the nature of the mobile phone data used in this time, the research has limitations. If you want to deeply analyze the weekend activity behavior and spatial distribution of a certain group of people or an activity, you need to cooperate with the activity log. Questionnaire survey to analyze.

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