Analysis of Urban Points of Interest and Urban Traffic from Shenzhen Urban Space Optimization

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Abstract. This paper is to discussing traffic accessibility and point of interest spatial network on the relationship between urban point of interest and the urban road network, First, we introduced the distribution of POI (points of interest, such as business, banking, catering, and attractions), and determining the road traffic and accessibility of cities through urban map data. Secondly, the spatial network formed by the POI is used to find the main factors, analyze the correlation between road traffic density and the road traffic density. Finally, the GIS platform is used for data organization for system analysis, mining urban data to obtain feature factors, and urban space optimization strategy. The studies results show urban POI affect road traffic through functional attributes, leading to changes in urban space.

1. Introduction

With the continuous development of data mining technology, urban data have been indifferent or difficult to complete by statistics have emerged continuously. This kind of data is plentiful and diverse and the understanding of urban space through the traditional analysis paradigm is more and more complicated. The data are generated mainly from the city's own progress and activities accompanying humans, while the Internet platform and mobile phone technology drive the increase of data, resulting in geometric growth of data and real-time updates. These data are expressed from various aspects of the urban spatial form and the various forms of expression are to be submitted, especially for the distribution of human populations and human activities. These composite data are basically challenging to implement for off-the-shelf technology. In particular, real-time data are notoriously difficult to control. The usual methods are built on some representative data for focus analysis. Therefore, data mining and data analysis become future breakthroughs. As a new type of reform and opening-up city in China, from the perspective of urban development, the city is mainly designed by administrative means. [1]. These designs are essentially based on the primary satisfaction of the function, the spatial form of the city has obvious functional characteristics compared to the naturally generated city. The characteristics of urban space help to reflect effective eigenvalues in the process of data analysis and explore urban spatial optimization strategies in depth in Shenzhen. Urban mining data has characteristic of various type, and these studies are mainly aimed at exploring points of interest (POIs) in urban data. The formation of municipal POIs are mainly expressed in geospatial space by means of coordinates in the form of points. [2] Urban spatial information has characteristic of various type Similar to the location of a house above the map in the form of points In practical application. In addition to the latitude and longitude coordinates, POIs has physical specific
information, such as house number, family population, telephone number and other related data, all of which have a point to control. It is owned by the form of abstracting urban spatial features into simple points from the perspective of POIs[3]. A single point can only display the information of a single entity, which is bound to urban space research, a large number of cluster points are needed as research objects and the distribution of these points are affected in urban space. The study of the relevance of urban space have been discussed by many scholars, especially POIs are used in urban spatial morphology analysis [4]. In these studies, a lot of POIs are combined with population density to replace population density distribution. For the lesser association of POIs and road traffic, because the real-time data are generated by traffic correlation that it is difficult to grasp. For traffic analysis, urban spatial form are more used for road accessibility and urban form relationship. The focus of the paper is tantamount to transform a perspective and using POIs are conducted research on the correlation between spatial network connectivity and urban road accessibility. Such advantages have a significant impact on the distance between POI and road accessibility.

2. Study area and data

2.1. Study area
Shenzhen is located in the coastal area of Southern China that it belongs to Guangdong Province and it is composed of six areas from the perspective of urban administrative planning: Baoan District, Futian District, Longgang District, Luohu District, Nanshan District and Yantian District(Fig.1). Among them, Futian, Luohu, and Yantian are close to Hong Kong. From this geographical location, the more developed areas of Shenzhen are the three regions too, which has the highest commercial, living and catering than other places. For example, Huaiqiang North is situated in Futian District that electronic commodities of concentrated areas. The famous Lotus Hill Park and Shenzhen Golf Club are situated in this area in Shenzhen. The main reason for these areas being development than other areas and Hong Kong trade were specially set up in the early Shenzhen, the port was put in place in Futian and inland of tourists had to enter the port to come in Hong Kong and the region was economically fast development after Hong Kong returned to China in 1997. In recent years, Shenzhen has begun to build the Greater Bay Area of Guangdong, Hong Kong, and Macao. The overall economic level of Shenzhen will be reclassified to the next level with the support of the state. In the future, the eastern coastal areas of Shenzhen will have higher progress, it is hard to say that it is developing along the trend zone from the perspective of the urban form of Shenzhen. In this respect, many scholars have carried out in-depth thinking[5]. Futian gradually spreads to Other areas[1] are the most obvious. Therefore, avoid the space-time evolvement of urban space, analyze the existing data of the city and find the impact factors. these data can be reflected by the current means of POIs.

![Figure 1. Urban area location map](image-url)
2.2. Point of interest (POI)
Shenzhen has a large number of urban interest points on the internet, this study mainly uses four kinds of POIs: commercial, banking, catering, and scenic spots. The business includes shopping, entertainment places, and living areas. Choosing these four types of POIs can show the aggregation of real-time data of the urban population and these POIs also have certain characteristics[7]. The data of POIs come from data mining and base on Baidu's statistics on the Internet[8] (Fig. 2). These data are mainly through the user's mobile app and commercial information input, which is not comprehensive from a scientific point of view. This is primarily due to the limitation of technical mining and resulting to obtain all the data of the city in the inability, but this also involves the state secret. From the urban perspective, these data are essential for distribution, so using these points for density analysis are very important. The acquired POIs are processed by the GIS platform and each single point information is converted into a visual plane level grid (Fig. 3) these a number of points are also unfolded in this area. As for the urban space are more complicated. Less data aggregation of blue dots and the less the function of urban space, the correspondence is only for the functional properties of individual POIs. In addition to the mass accumulation in urban space, POIs hopes to provide some intrinsic information too, which is useful for the influence of spatial characteristics. In addition to the POIs density map analysis, Point-to-point spatial network connection is based on POIs to perform spatial analysis and look for intrinsic topological relationships. Each point has specific latitude and longitude information above the map in the POIs. These positions belong to the unique attribute of a distinct point. There is not any intrinsic connection between the points. The position of each point is mainly to meet the operative needs. There is no practical significance for the overall municipal space. Therefore, to establish a longitudinal perspective of all points. the main purpose of selecting the closest distance these points are to prevent artificial interference so that all the points will form a trajectory in the urban space. These trajectories have not been discussed yet, but point analyses can be seen the distance there is some connection between points. Therefore, POIs are closely linked by traffic.

Figure 2. Urban POIs statistics
2.3. Traffic data

The most important influence of Shenzhen's spatial form is urban traffic and road grid. Urban transportation divides the city into plots of various functional attributes and the connection urban space also is required to rely on roads. The main road for Shenzhen is the east-west direction of the Beijing-Hong Kong-Macao Expressway-Shennan Avenue-Huishen Coastal Expressway (Fig. 4). The north-south direction runs through the Guangzhou-Shenzhen Expressway, the Nanguang Expressway and the Ganlong Expressway are forming a network-type road traffic trend. Take into account this foundation, numerous secondary roads are derived to form a checkerboard pattern. Basically, human intervention has a significant impact (Fig. 5). The road grid of Shenzhen was drawn by using the open street map as analysis and the data was corrected by satellite image comparison. Density processing of the acquired road grid can find the areas where the roads are the most concentrated because these roads are complex and the diverse functions of blocks affect the development of the roads (Fig. 6). The spatial form is likewise particularly complex. The impact of these complexities on space is mainly in traffic flow, such as traffic jams in cities, urban traffic pollution and so on.
3. Study Details

Using GIS platform [9] to overlay the POIs map with city maps, it can see the overall distribution of POIs data. Commercial POIs are mainly distributed in Futian District and Nanshan District. Catering of POIs are mainly distributed in Futian District, Luohu District, Nanshan District. Attractions of POIs mainly distributed in Baoan District, Longgang District and Nanshan District, and bank financing of POIs are mainly distributed in Bao'an District, Futian District and Longgang District (Fig. 7). It can be seen from the map that Futian District and Nanshan District are the most allocated. It’s evident that the urban spatial function attributes of these two regions are complex with great development. The POIs density map is mainly calculated by the atomic density formula[10], and the point cluster distribution is generated to generate a heat map visualization. Although the urban spatial distribution can be seen through the POIs thermogram, the impact on the urban spatial characteristics factor does not achieve the intended purpose Therefore, the study of urban spatial characteristics is carried out by introducing municipal roads as entry points. Shenzhen's road network data mainly come from open street map[11]. Shenzhen's street data are particularly complex and have a large amount of data. In the process of analysis, the road network density map is finally analyzed. The road network density map is calculated by the road network density formula[12]. The calculations are made on the GIS platform by means of superimposing the road network density map and the city map. the most densely distributed area of The urban road network is sought as the cut-in entrance. First, the road network and the urban satellite image are superimposed. It can be observed that the most densely populated areas have Bao'an District, Futian District, Luohu District, and Nanshan District, among which Futian District and Nanshan District has the highest density(Fig. 8). In order to verify that the road network and POIs are higher than other areas in Nanshan District and Futian District, the POIs density map and the road network density map are superimposed to find the internal relationship (Fig. 9). Depending on the results of the density map superposition, the density of Futian District is the highest followed by Nanshan. However, the effect of visualization is not satisfactory, so for more in-depth comparison, the correlation data are compared using by the natural breakpoint of classification method (Table 1). Intermediate value data statistics were analyzed by the natural breakpoint of classification method and the trend was compared by linear regression of the POIs data and the road network data. The trend graph shows that the commercial density data is closest to the road network density data (Fig. 10), so the commercial POIs are analyzed by Euclidean direction to find the distribution of all points in the urban spatial direction to determine these points of spatial distance. (Fig. 11)The Euclidean Distance analysis was also performed on the basis of the Euclidean Direction combined with the borough road network to determine the closest relationship between POIs and road (Fig. 12).
**Figure 7.** POIs overlap with satellite images

**Figure 8.** Urban transport heat map and satellite map

**Figure 9.** POIs density map and road network density map overlay
Table 1. POIs density and road density natural discontinuity grading data

| Road network | Food     | Bank      | Business | Attractions |
|--------------|----------|-----------|----------|-------------|
| 1.397889485  | 21,466.73 | 11,716.69 | 30,622.08 | 1,577.92    |
| 3.883026347  | 67,977.97 | 39,055.63 | 97,990.65 | 5,364.94    |
| 6.212842156  | 118,067.00| 68,347.36 | 171,483.64| 10,098.71   |
| 8.38733691   | 171,733.82| 95,686.31 | 244,976.63| 14,832.48   |
| 10.56183167  | 225,400.64| 121,072.47| 324,594.03| 19,250.66   |
| 12.73632642  | 282,645.25| 148,411.41| 422,584.68| 23,984.43   |
| 15.06614223  | 347,045.44| 179,655.92| 526,699.75| 29,349.37   |
| 17.3955804   | 411,445.62| 212,853.21| 630,814.82| 34,714.30   |
| 19.72577384  | 475,845.80| 248,003.28| 728,805.47| 40,079.24   |
| 21.9002686   | 540,245.99| 285,106.13| 826,796.12| 45,128.60   |
| 24.23008441  | 604,646.17| 324,161.77| 937,035.60| 50,493.53   |
| 26.71522127  | 665,468.57| 361,264.62| 1,071,772.75| 56,489.64  |

Figure 10. Linear regression diagram of Road network and POIs

Figure 11. Commercial POIs Euclidean recent direction and distance analysis
4. Discussion

Obviously, urban POIs have a close relationship with municipal roads, which are mainly caused by urban main roads. Because the convenience of urban cities requires the road to support and POIs needs the convenience of urban roads. Accessibility, urban roads directly affects the development of urban POIs. The reasons for this can be a case (Fig. 12). First, it can be observed that the direction of the POIs is mainly along the direction of the road and the adjacent areas to form a spatial field, thereby determining the municipal spatial layout (Fig. 11). In order to explore the influencing factors of urban space, the road network and POIs are utilized to analyze the Euclidean distance. It is possible to conclude that commercial distribution is closely related to the highest traffic in Shenzhen. The red street is the closest to the POIs (Fig. 12). The high accessibility of these streets is particularly convenient. At the same time, these streets are assigned to the most prosperous areas of Shenzhen, such as Nanshan District and Futian District. However, the Longgang area is not shown because of the low accessibility of the road or the lack of roads, so there is no display (Fig. 12), but there is no viable distribution in Longgang District. The research is that the urban space is mainly influenced by road and transportation system in the information era; the urban space is mainly determined by the accessibility and convenience of borough roads. Although the result is based on the formation of spatial locations of POIs and lack of scientific data to support. this is also determined by the POIs themselves. However, trend development can be supported in the process of urban space optimization strategy and sustainable development. In particular, commercial POIs and dietary POIs are particularly evident in trends. Reconstruction and optimization of municipal roads, which play a vital role in the urban spatial form, requires special attention at this stage. It is worthwhile to think about how to better the accessibility and convenience of municipal roads. For the current stage of road optimization, it is based on the spatial syntax model, which only analyzes the accessibility of the road, but lacks the connection of various functional attributes in the urban space. Therefore, POIs are particularly esteemed for the assistance of urban space.

5. Conclusion

In this paper, we propose using the POI to determine the correlation between the spatial field and the city streets and conclude that the optimization of the urban space is mostly in the accessibility of roads and comfort optimization. First, the satellite map is overlaid with the urban POI density map to
examined the distribution of strategic regional sites in Shenzhen. Second, the Shenzhen road map was called as auxiliary data and the POI density map was superimposed to designate the Nanshan District and Futian District. The linear regression was performed using the geographical separation data of POIs and roads, and it was found that the commercial POIs have the greatest impact on the road. Finally, Commercial POIs and the road network can be analyzed one to one correspondence principle in the Euclidean distance and Euclidean direction. The reason why the mercantile landmarks in Nanshan County and Futian District are high is that the urban road network in the region is accessible. Therefore, the road network determines the spatial morphology.

6. References

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