

Analysis of Time Characteristics of Traffic Congestion in Shanghai based on Road Condition Data of Gaode Map

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Abstract

With the continuous increase of urban population, the rapid development of economy and the continuous improvement of urbanization level, the number of urban motor vehicles is also rising. While motor vehicles bring convenience to people's lives, they inevitably cause urban traffic congestion. Traffic congestion has attracted the attention of many experts and scholars both at home and abroad in recent years, which has triggered many discussions. The root cause of traffic congestion is the imbalance between traffic supply and demand. Based on the theory of clustering analysis, this paper collects the real-time congestion data of Gaode Map on the basis of summarizing relevant theories and literature, and uses hierarchical clustering analysis method to analyze the temporal and spatial distribution characteristics of congestion data in Shanghai research area. Through empirical analysis, the conclusions are as follows: Shanghai has obvious time characteristics, and the time characteristics of working days and weekends are different. There are obvious early and late peaks on working days, while the early and late peaks on weekends are relatively gentle.

Keywords

Traffic congestion, Congestion characteristics, Feature analysis.

1. Introduction

1.1. Research Background

With the increasing number of foreign population, the rapid development of modern economy and the continuous advancement of urbanization, the traffic congestion in Shanghai is becoming more and more serious. Traffic congestion will cause many serious consequences, not only aggravate air pollution and noise pollution, but also increase travel costs and reduce residents' travel satisfaction. As a mega city with a population of nearly 25 million and a vehicle ownership of nearly 4.2 million, traffic congestion has seriously affected the living standard and travel experience of urban residents, and also restricted the sustainable development of the city. The initial urban road network planning and construction in Shanghai is not perfect. From a historical point of view, in the 1830s, the world powers divided Shanghai into concession blocks. They planned and built road networks within the concession, which could not achieve overall planning. Moreover, the roads in the central city of Shanghai were narrow, the distance between intersections was too short, there were many T-junctions and broken roads, and the road network was low. However, in the early planning, due to the lack of foresight, insufficient prediction of the development trend of motor vehicles, and problems in the planned road network, the newly built road network can not fully play its role, and there are many ramps, branch roads and secondary trunk roads in the city center, which are difficult to split immediately, which makes the elevated roads easy to be congested. At the same time, the construction of Pudong Avenue has a negative impact on the original east-west, east-west and east-west. The South-North traffic structure has an impact, resulting in many six fork

intersections, the traffic at the intersection is complex, and the traffic efficiency is greatly reduced. [1]

As an international metropolis, the cost increase and economic loss caused by traffic congestion in Shanghai is far greater than that of ordinary cities. However, from the comparison of the growth of vehicle ownership and the change trend of highway mileage in recent years, it is found that widening roads or building roads can not effectively alleviate traffic congestion, and an effective measure is found to slow down or even fundamentally avoid traffic congestion, It is particularly significant.

1.2. Research Status

In 1990, at the urban traffic congestion supervision conference held in the United States, pisarski summarized the characteristics of traffic congestion as congestion degree, congestion intensity, congestion duration and congestion Scope [2]. Since then, a lot of researches on the monitoring, propagation and generation mechanism of traffic congestion at home and abroad have been carried out around these traffic characteristics.

Bertini conducted a survey around 2005 to explore people's understanding of the basic characteristics of traffic congestion. According to the survey, respondents generally regard travel time, traffic speed, congestion scale, road service level and periodic failure of traffic signals as the basic characteristics of traffic congestion. Among them, the road service level refers to the road network scale, traffic volume, density, reaction time for problems, and the number of stops through a certain section [3].

Meyer, Byrne and Michael established the main evaluation indicators of urban congestion, but they were unable to give the specific situation of congestion at different times and places [4-5]. In other words, these indicators are only put forward in the form of theory, and there is no specific model for quantitative analysis. However, these indicators can provide modeling factors and enrich the content of this paper.

2. Collection and Processing of Traffic Congestion Data in Shanghai

2.1. Data Acquisition

Combined with the previous research experience, the formal data collection time is from May 7, Tuesday to May 13, Monday, and the official data collection period is 7:00-9:30, 16:30-19:30, and the time interval is 10 minutes.

Anaconda is used for pre collection and formal collection of data, and finally a table with the extension of CSV is formed. The table contains all the data of crawling points within the scope of crawling at a certain time in a certain day, including the name of the road to which the point belongs, the grade of the Road, the moving direction and moving speed of the point.

2.2. Data Processing

Mainly through observation, check whether the format of each table generated is correct, whether the data contained in the table is complete, whether there are omissions, whether the cell format is correct and whether there are garbled codes.

The initial collected data range is large, and a large number of data in the non study area will cause great interference to the subsequent data processing and analysis. Therefore, before the formal data processing, first delete the data in each table, and delete the data whose longitude is not between E121.406730 °-E121.576257 ° and longitude is not between N31.176605 ° - N31.2888880 ° to make data processing more convenient.

The crawling data include the date and time of climbing, the name of the road, the grade of the road, the speed and direction of the road, the speed of a point on the road and the longitude and latitude position of the point.

Table 1. Classification of average travel speed of road sections (km / h)
(The level 1-5 congestion gradually increases)

	1	2	3	4	5
Expressway	>65	(50,65]	(35,50]	(20,35]	≤20
Trunk road	>45	(35,45]	(25,35]	(15,25]	≤15
Secondary trunk road	>35	(25,35]	(15,25]	(10,15]	≤10
Access road	>35	(25,35]	(15,25]	(10,15]	≤10

After the preprocessed data list, a new column named condensation is created. According to the related principles of direct cluster analysis, the collected points are divided and assigned uniformly with status and speed as the classification categories. Name the condensation according to table 1. The proportion of cells with median values of 5,4,3 in the total data during peak hours can be calculated as the proportion of congestion length to total line length, and the speed change of congestion range increasing and dispersing during peak hours can also be seen.

3. Analysis of Traffic Congestion Time in Shanghai

3.1. Total Time Characteristics of Peak Hours in Workdays

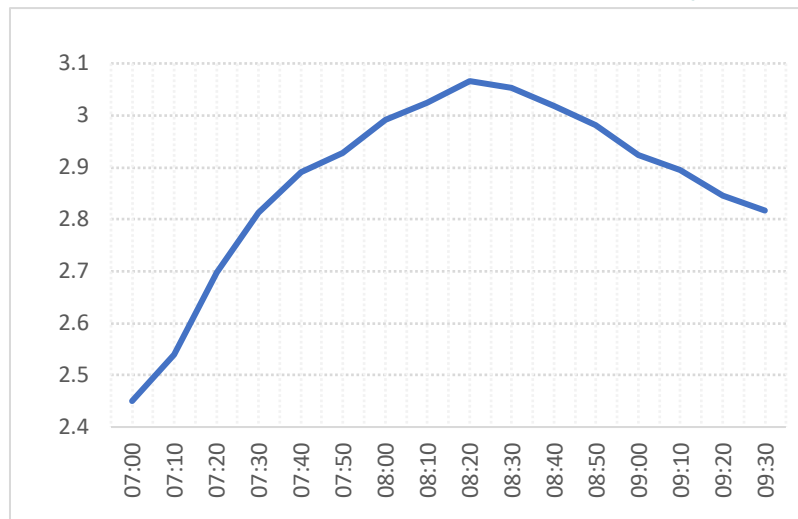


Figure 1. Average speed level of morning peak on weekdays

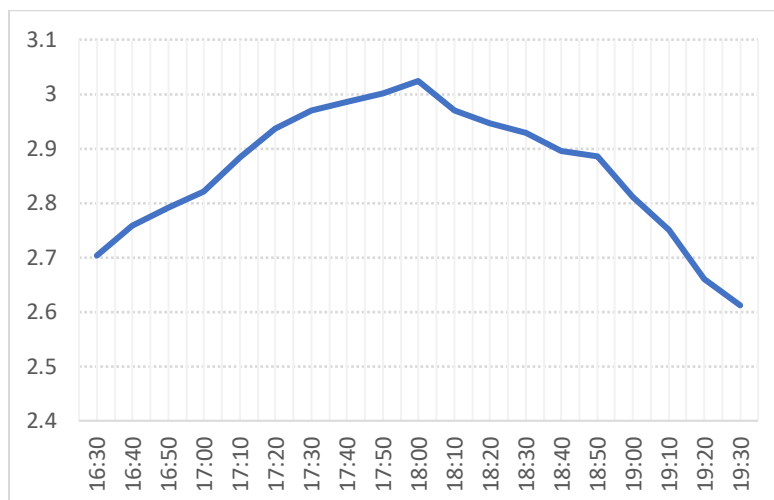


Figure 2. Average speed level of working day evening peak

As can be seen from Figure 1, there is an obvious morning peak in Shanghai. The aggregation time of congestion is slow, reaching the peak around 8:20, but the dissipation speed is fast, and it has reached the level of basically unblocked before 9:30.

As can be seen from Figure 2, the working days in Shanghai also have obvious evening peaks. The peak time of congestion is around 18:00, but the dissipation speed is slow.

Compared with the morning peak on weekdays, the late peak duration is longer, but the peak is lower. It takes the opposite time for congestion to gather and dissipate.

3.2. Total Time Characteristics of Peak Periods on Rest Days

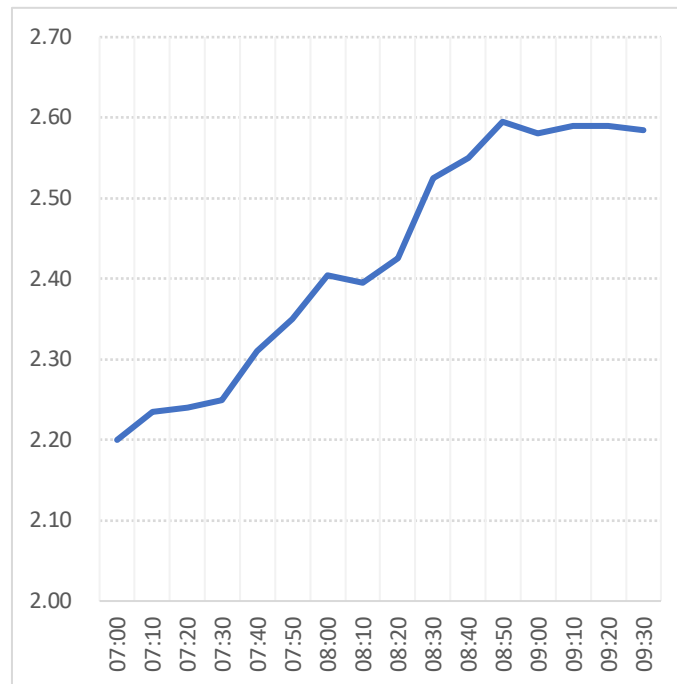


Figure 3. Average speed level of morning peak on rest day

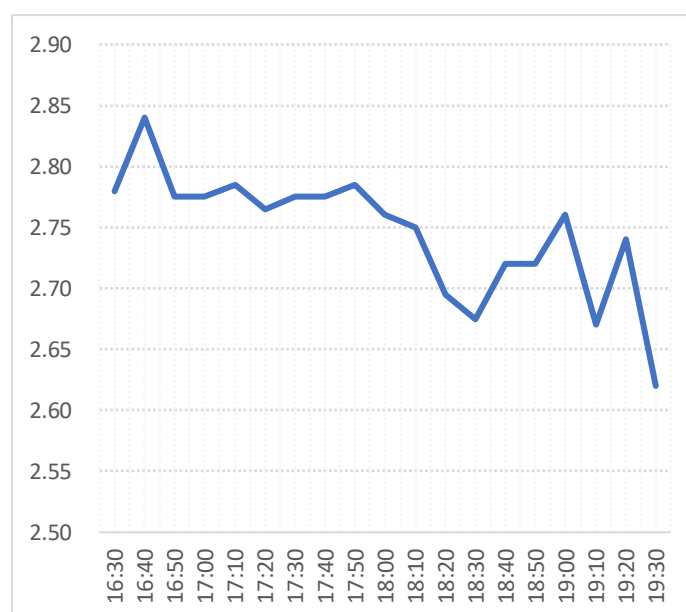


Figure 4. Average speed level of evening peak on rest day

As can be seen from Figure 3, there is no obvious trend of congestion accumulation and dissipation, and no obvious peak value. However, it tends to be stable after continuous rise, but the rise is relatively slow. Compared with the early peak congestion on weekdays at the same time, the degree of congestion is much lower, and the roads are generally in a relatively smooth state.

As can be seen from figure 4, there is no obvious peak in the evening peak of Shanghai's rest day, and the overall degree of congestion shows a fluctuating downward trend, and the downward trend is very slow, but the congestion state is also relatively slight, and the overall situation is basically unblocked.

4. Conclusion

According to the actual situation, the early peak of working day is concentrated at 7:00-9:30, lasting 2.5h, with a short duration and serious congestion. The late peak is about 16:30-19:30, which lasts for 3 hours, and the duration is longer, but the congestion at peak is relatively good. We can know that when we look up the relevant data and contact the actual situation, this is mainly because the people work and go to school in the early rush hour, and the number of motor vehicles travel increases accordingly, which results in the dense traffic and congestion in a short time. After the time point of work and school, the travel target is completed and the number of motor vehicles is greatly reduced. In the late peak, the time of the people off work and after school is inconsistent, and the travel purpose after work and after school is not centralized, so there will be no concentrated travel situation of the public like the morning, most of which are staggered peak travel. Therefore, the peak value of the late peak is not high, and the congestion is not serious. However, the duration of the late peak is longer than the early peak.

In the early peak of the rest day, commute demand is greatly reduced compared with working days, which leads to the corresponding reduction of the number of motor vehicles in the normal early peak period and the reduction of concentration. Therefore, there is no rapid growth of congestion areas such as the early peak of working day. However, other travel needs of some citizens should be considered. Therefore, although the early peak of the rest day will not be out Serious congestion will occur, but moderate congestion will occur. As for the evening peak of rest day, there is no obvious peak value in the same way as that of working day evening. Compared with the peak time of working day, the travel time of citizens is more scattered and the purpose of travel is more diversified. Therefore, the congestion degree of the peak on the rest day night is slightly better than that of working day night peak.

References

- [1] Yang guangcan. Analysis and suggestions on urban traffic congestion in Shanghai [D]. Tongji University, 2008Bertini. You Are the Traffic Jam: An Examination of Congestion Measures[M]. 2005.
- [2] Meyer, Michael. Alternative Methods for Measuring Congestion Levels[C]. Transportation research Board, 1993
- [3] Byrne, G. E. and S M Mulhall. Congestion Management Data Requirements and Comparisons [C] Transportation Research Record, 1980
- [4] Gu Y L , Yan X Q , Wu J Y . Spatial and Temporal Characteristics for Traffic Congestion Based on Microwave Data[J]. Advanced Materials Research, 2013, 838-841:2107-2112.