Research on Traffic Congestion of Urban Main Road under Accident Conditions

Jianjun Wang  
Chang’an University  
Middle-section of Nan'er Huan Road, Xi’an, China  
Wjjun16@163.com

Jiaxin Sun  
Chang’an University  
Middle-section of Nan'er Huan Road, Xi’an, China  
Doriajx0209@gmail.com

ABSTRACT

With the continuous progress of urbanization in China, vehicle ownership is still rising, and urban traffic is facing with severe pressure. At the same time, urban traffic accidents occur frequently, resulting in traffic congestion, reduction of road network operation efficiency, and adverse losses to the social economy. For traffic accidents on complex urban road networks, it is urgent to solve the urban traffic problems in order to dredge and reduce the probability of disaster, to reduce the impact of the road network and maintain the smooth and efficient operation of the road network traffic flow. To solve the problems, it is significant to have a clear understanding and evaluation on the development law, impact scope and severity of the traffic congestion caused by the accidents.

On the basis of the existing research results in China and abroad, this paper studies the law of the generation and spread of road congestion under accident conditions, and analyzes the factors affecting the development of congestion situation and its mechanism. Aiming at the urban trunk road, the prediction method of the spatial influence scope formed by the spread of accidental congestion on the road network space after the accident is studied, and the severity of traffic congestion situation under the corresponding traffic conditions is evaluated.

KEYWORDS: traffic congestion situation, congestion spreading speed, congestion impact range, accident conditions

1 INTRODUCTION

With the improvement of the traffic theory research and the progress of science and technology, the effect was obvious in urban traffic development in our country and there is no denying fact that from the point of view of current urban transportation development process, most cities in our country, especially in economically developed big cities, the urban traffic in development still faces some serious problems:

First, the ever-surging car ownership and the limited urban road space resources have led to the sharp contradiction between urban road traffic supply and travel demand, and the phenomenon of urban traffic congestion is widespread.

Second, the safety of urban roads is still unsatisfactory. The number of traffic accidents and the extent of losses are still at a high level. Although cities across the country have established traffic safety policies at a certain level, data from the 2016 national economic and social development statistical bulletin released by the national bureau of statistics shows that the number of road traffic
accidents nationwide in 2016 was 21,000, the same as in 2015 (National Bureau of Statistics official, 2016).

Third, most of the urban road traffic overloaded in the country. For road incident emergency response and vulnerability management, in the face of urban complex traffic accident on the road network, reducing network spread effect, maintaining the road network traffic flow smoothly and orderly operation ability needs further improvement.

As accidental factors of urban road traffic accidents have the characteristic of randomness, it is difficult to predict the time and place. In the event which can easily result in the loss of the road traffic and lead to traffic jams, comparing with the road network, it is very important to have an urban road network that is strong, the density of nodes should be at a high level, which determines the local congestion in road accidents are more likely to have a negative impact on the surrounding road network, and evacuation is difficult. As the accident lasts for a long time, the traffic congestion situation will continue to develop and change, constantly affecting the operation state and efficiency of urban roads. If the traffic accident occurs in the existed congested channel section or the intersection, or frequently occurs in the rush hour, the consequence will be even worse.

In conclusion, based on the problems of the urban traffic development, the paper would put forward the following research questions: (1) whether the urban road traffic accident will cause regional road network traffic congestion; (2) If the accident causes accidental traffic congestion, how will the congestion situation evolve in the road network space over time and what factors will influence and restrict it in the evolution process? (3) How to effectively predict and evaluate the congestion situation caused by accidents is expected to provide theoretical basis and strategic support for urban traffic system management departments to formulate management and control technologies such as accident handling and congestion evacuation.

In this paper, traffic congestion situation refers to the development situation and distribution status of accidental congestion caused by accidents in urban road network under traffic accident conditions, including the law of congestion spreading development, the speed of congestion spreading on the road network and the spatial influence scope of congestion. Traffic congestion situation prediction is mainly aiming at predicting the spread speed and spatial impact scope of traffic congestion caused by accidents, while traffic congestion situation assessment is aimed at assessing the development situation of traffic congestion and the severity of the consequences caused by accidents. According to this, the research of this paper has important theoretical significance and practical application value for the prediction and evaluation of urban road traffic congestion situation under the condition of traffic accidents, which can be specifically reflected in the following aspects:

1. An in-depth analysis of the influencing factors and influencing mechanism of urban traffic congestion under accident conditions which enriches relevant content of traffic flow congestion characteristics from a theoretical perspective, and provides new ideas and points for solving congestion problems.

2. The study on the characteristics of the spread and evolution of the congestion situation under the condition of traffic accidents which can reveal the formation and transmission mechanism of occasional congestion in the urban traffic network as well as the action mechanism of traffic control measures. Then the a theoretical foundation for congestion control and evacuation will be explained.

2 THEORETICAL BACKGROUNDS

On the traffic flow model under the impact of accidents, on the foreign side: Morales proposed to estimate the total delay caused by the event of using the arrival-departure rate curve, and the authors calculated the congestion duration and queue length. Because the model assumed that the arrival rate and departure rate are exact values, so it is difficult to carry out real-time estimation of the traffic state (Morales,1986).

After that, T.N. Agatani simulated traffic congestion based on cellular automata model and discussed the impact of accident occurrence on dynamic congestion phase transition (T.N.1993); Then Lawson improved I/O model and used it to estimate the time and space range of the vehicles in the bottleneck section by tracking the vehicles at the end of the queue (Lawson,1997). However, this
model assumed that the vehicles had a fixed arrival and departure rate, which is not applicable to the bottleneck of the over-saturated intersection. Several years later, D. Helbing provided a dynamic queueing network model to divide the road into long and uniform sections with constant traffic capacity to describe traffic flow hysteresis and typical blocking patterns (Helbing, 2003), but the accuracy was insufficient. Based on other study such as LWR model, E Bourrel with JB Lesort combined with macro and micro traffic flow model, and a hybrid model was proposed, which can reflect the formation and dissipation process of queues caused by traffic events (Bourrel, 2003).

In China, according to traffic wave theory, Wang (2007) established a wave velocity model based on V-K linear model under the action of traffic incidents and intervention measures, and analyzed the interaction among the gathering wave, the starting wave and the dispersing wave generated by the incident and the interference wave; Yongsheng Qian built a cellular automaton model of expressway traffic flow under control conditions based on Nash model, considering the impact of accidents, and simulated the impact of congestion events and length of congested sections on traffic flow (Qian, 2011); After that, Huiying Wen and Jun Luo used cellular automata to study the queue length differences in different interference areas caused by short-term traffic events on one-way two-lane highway (Wen & Luo, 2012).

In the existing literature at home and abroad, studies on the scope of crowded space cover frequent congestion and accidental congestion, and mostly focus on the estimation of queue length at the micro level, while the study on duration mainly estimates the time of accidental traffic congestion. In foreign aspects:

Michalopoulos according to the principle of fluid dynamics, a traffic wave model is proposed to estimate the diffusion range of accidental congestion by analyzing the propagation speed of traffic waves (Michalopoulos, 1981); Wright and Roberg after simplifying the characteristics of road network and traffic flow, a static analytical model of traffic congestion propagation under accident conditions was established (Wright, 1998). Kwon and Varaiya etc. based on the traffic flow, speed and the time and place data of traffic events, an algorithm is proposed to estimate the space-time influence scope and delay of expressway traffic events (Kwon and Varaiya etc., 2005).

In China, according to the severity of the incident, Yao (2005) proposed a method to calculate the travel time of the accident section when the traffic capacity of the accident site is lower than that of the upstream road; Liu (2006), aiming at frequent congestion, establishes prediction models of congestion diffusion range in road sections based on mobile and fixed detectors respectively; Xiang used fixed detector to design CTM queuing model to estimate the congestion diffusion range of single urban section (Gao, 2008); Chen & Wang (2009) combined static multi-path traffic assignment with cellular transmission model, and used simulation to study the spatiotemporal regularity of road network congestion formation and dissipation before and after large-scale events; Li clustered the extracted traffic flow parameters and then carried out fuzzy processing. An adaptive-neuro-fuzzy reasoning system was established to input real-time traffic flow parameters to identify congestion status (Chen, 2011).

The researches on the duration of congestion are mainly based on probability statistics, regression analysis and other methods at home and abroad, which are mainly used to predict the duration of congestion caused by expressway emergencies. Golob et al. carried out statistical analysis on nearly 200 traffic accidents of Los Angeles and California expressway in two years, and concluded that the duration of traffic accidents followed logarithmic normal distribution (Golob et al., 1987). Garib (1997) established a linear regression equation for the duration of 205 events in Auckland and California, including the number of lanes, vehicles, conditions of events and weather. Cottrell developed a congestion duration model to estimate the duration of congestion bottlenecks in road networks (Cottrell, 2001). Liu (2006) used regression analysis and decision tree to predict the duration of high-speed traffic incidents. Guiyan Jiang studied the regularity of frequent congestion diffusion on urban main roads through the change of vehicle queue length, and predicted the duration of congestion through N-curve (Jiang, 2006). Xingyu analyzed the floating car data of bottleneck section of Beijing Expressway, and gave a quantitative method to determine the duration of the transition between stable state, congestion formation, congestion formation and congestion dissipation (Feng et al., 2014).
3 METHODOLOGY

The technical route for the prediction and evaluation of urban trunk road congestion situation under accident conditions is shown in figure 1.

![Flow chart of technical route](image)

**Figure 1: Flow chart of technical route**

### 3.1 factors of urban road traffic congestion situation under accident condition

The generation, spread and distribution of congestion on the urban road network are affected by various factors in the urban traffic system, especially the accidental congestion generated under accident conditions. Due to its unique suddenness and randomness, the development of congestion situation is more closely related to the influencing factors. This chapter mainly discussed the types and mechanism of urban road congestion, studies the influencing factors of urban accidental congestion situation under accident conditions, and clarifies the basic scenario of this paper, providing the background basis for the prediction of the spatial scope of the subsequent road traffic congestion situation.

- **factors of urban road traffic congestion situation under accident condition**

Traffic congestion generally refers to the phenomenon of vehicle queuing and delay in the local part of the road system caused by some reasons, which generally occurs within a relative time and space. The essence of this phenomenon is the emergence of traffic bottlenecks, that is, there are components in the road system where the traffic demand exceeds the capacity, thus causing the stranded vehicles to form a queue on the road. Vehicle congestion queuing is a direct feature of traffic congestion and an intuitive manifestation of road traffic operation failure.

There are many causes of Congestion. According to its differences, Congestion is classified as Recurrent Congestion, non-recurrent Congestion and Mixed Congestion. Often is crowded by the traffic flow increases suddenly, beyond the road facilities, which is caused by the normal capacity of commonly occur in the space of urban roads is relatively fixed position and time, in the form of relatively stable, regular and predictable, often crowded easily occur in the travel peak, performance for the period of traffic demand constant beyond normal capacity, road facilities has a significant objective characteristic; Accidental congestion is caused by some special emergencies, resulting in the reduction of road capacity or excessive traffic attraction. It occurs in random spatial locations and time periods, which are irregular, unpredictable and may last for a long time (Gao, 2008)(Zhang, 2008). Common road emergencies, such as large-scale activities, traffic accidents, road construction, bad weather, geological disasters, etc., may cause accidental congestion. When frequent and sporadic congestion occur almost at the same time, or when it is impossible to distinguish their order, the road
presents a phenomenon of congestion called mixed traffic congestion, such as in the rush hour special events may cause such a type of congestion (Chen, 2005).

The operation status of urban road system is mainly reflected in the real-time movement of road traffic flow. If there is a congestion somewhere in the road system, without external measures, the congestion will spread in the corresponding section or even in the road network space over time. According to the order of causing Congestion and causation of causing Congestion, Congestion can be classified into Primary Congestion and Secondary Congestion. Primary congestion refers to the initial congestion formed at the bottleneck of road traffic, which is the source of congestion diffusion. Secondary congestion refers to the congestion formed by the spread of primary congestion to the surrounding area, which can be defined as primary secondary congestion, secondary congestion and tertiary secondary congestion according to the order of its generation (Song, 2013).

In this paper, the road congestion situation under accident conditions is studied, which mainly involves the generation, spread rule and spatial influence scope of accidental traffic congestion, and takes accident occurrence as the inducement to study the correlation between the primary congestion generated by the accident itself and the secondary congestion caused within the duration of the accident.

- **analysis of urban road congestion characteristics**

The characteristics of urban road congestion are analyzed from the aspects of sprawl, drift and spatial distribution.

1. Sprawl. Urban road network consists of roads and intersections, and the condition of roads and intersections traffic influence each other, when somewhere crowded phenomenon produced in road network, affected by the crowded appear within a certain time delay of vehicles build-up, line up after discharge, crowded coverage expansion, crowded along the initial point to the upstream or spread of surrounding roads and intersections, upstream is for road crowded spread characteristics. The speed and scope of congestion spread are affected by the form of road network, the location of the original congestion and the initial congestion intensity.

2. Drift. Generally speaking, road congestion initially appears in a section or intersection independently. This initial location can be called the congestion core, which is also the bottleneck. In the process of taking control diversion measures to disperse congestion, if the residual capacity of the road or intersection receiving the flow is not fully considered to accept the flow, the initial congestion is likely to dissipate, and the new congestion will produce a situation that the congestion is drifting.

Spatial distribution characteristics. According to the spatial characteristics of congestion, the formation and propagation of congestion can be described as the following three stages (Feng, 2008):

- Point congestion--traffic congestion occurs independently on a road section or intersection and does not affect the adjacent road section or intersection. There may be point congestion in the road network, but they are independent of each other.

- Linear congestion--the congestion spreads to the adjacent sections or intersections in the upstream successively and forms a linear correlation distribution in the road network and influences each other;

- Planar congestion--linear congestion diffuses through the interrelated sections and intersections of the road network, resulting in a network distribution of congestion, forming a regional traffic congestion state; In this stage, if no effective measures are taken to control the congestion situation, a congested closed loop, or "deadlock", may be formed in the road network, thus leading to the paralysis of a large area of the road network.

Point, line and planar congestion are shown in figure 2, where point congestion only shows the situation at independent intersection. Dots represent road intersections, bold lines represent congested sections, and arrows represent simplified congestion propagation directions.
Fig. 2 schematic diagram of point, line and planar crowding

- urban road congestion measurement indexes and standards

Evaluation index system of urban road traffic management issued by the ministry of public security of China (2008 edition) (Ministry of Public Security, 2008) The average travel speed of motor vehicles on urban trunk roads was used as the congestion index: (1) unimpeded: the average travel speed was not less than 30 km/h; (2) slight congestion: the average travel speed is less than 30 km/h and not less than 20 km/h; (3) congestion: the average travel speed is less than 20 km/h and not less than 10 km/h; (4) serious congestion: the average travel speed is not less than 10 km/h. At the same time, it is stipulated that the vehicles are blocked in the outer lane of the intersection without signal control and the queue length exceeds 250m, or the vehicles fail to pass the intersection after three green lights at the signals-controlled intersection, the intersection is considered to be in a crowded state, and the road section where the vehicles are blocked in the roadway and the queue length exceeds 1 km is a congested section.

Evaluation index system of urban road traffic management in China (2012 edition) (Ministry of Public Security, 2012). Divides the city scale, the main peak time and develop city proper scale of the average velocity, as shown in Table 1, some scholars as a traffic congestion measures for related research, evaluation class that corresponds to the smooth flow of traffic, the first and second level 3 and level 4 for general crowded, five corresponding serious congestion (Wang, 2008).

Table 1 Classification table of average speed (km/h) of main road in built-up area during peak hours

<table>
<thead>
<tr>
<th>Evaluation standard class</th>
<th>1st Clear</th>
<th>2nd Clear</th>
<th>3rd Usually crowded</th>
<th>4th Usually crowded</th>
<th>5th Severe congestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very large/ A class city</td>
<td>25 or higher</td>
<td>[22, 25)</td>
<td>[19, 22)</td>
<td>[16, 12)</td>
<td>[0 16th)</td>
</tr>
<tr>
<td>B Class city</td>
<td>28 or higher</td>
<td>[25, 28)</td>
<td>[22, 25)</td>
<td>[19, 22)</td>
<td>[0, 3)</td>
</tr>
<tr>
<td>C/D class city</td>
<td>30 or higher</td>
<td>[27, 30)</td>
<td>[24, 27)</td>
<td>[21, 24)</td>
<td>[0, 25)</td>
</tr>
<tr>
<td>index</td>
<td>[90,100]</td>
<td>[80,90)</td>
<td>[70,80)</td>
<td>[60, 70)</td>
<td>[0, 60)</td>
</tr>
</tbody>
</table>

Code for evaluation of urban traffic operation in China (GBT33171-2016)( National Quality Supervision, Inspection and Quarantine Bureau of the Chinese Republic, 2016). According to the relationship between the average travel speed of a section and the free flow speed, it can be divided into five grades: unblocked, basically unblocked, mildly congested, moderately congested and severely congested. At the same time, the conversion relationship table of such indicators as the proportion of mileage in severe congestion, the travel time ratio (TTI), the delay time ratio (DTP) and the traffic operation index was given, and the traffic operation status was classified according to this table, as shown in Table 2.
Table 2 road section traffic operation grade classification table

<table>
<thead>
<tr>
<th>Operating condition rating</th>
<th>Clear</th>
<th>Basically clear</th>
<th>Mild congestion</th>
<th>Moderate congestion</th>
<th>Severe congestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>The relation between average travel speed ( V_{ij} ) and free flow speed ( V_f )</td>
<td>( V_i &gt; V_f \times 70% )</td>
<td>( V_i \times 50% \leq V_f \leq V_i \times 70% )</td>
<td>( V_i \times 40% \leq V_f \leq V_i \times 50% )</td>
<td>( V_i \times 30% \leq V_f \leq V_i \times 40% )</td>
<td>( V_i \leq V_f \times 30% )</td>
</tr>
<tr>
<td>Urban traffic operation index</td>
<td>([0, 2)]</td>
<td>([2, 4)]</td>
<td>([4, 6)]</td>
<td>([6, 8)]</td>
<td>([8, 10])</td>
</tr>
<tr>
<td>Heavy congestion mileage ratio</td>
<td>([0, 4 %])</td>
<td>((4%, 8%])</td>
<td>((8%, 11%])</td>
<td>((11%, 14%])</td>
<td>(&gt; 14%)</td>
</tr>
<tr>
<td>Travel time ratio (TTI)</td>
<td>([1,1.3)]</td>
<td>([1.3, 1.6)]</td>
<td>([1.6, 1.9)]</td>
<td>([1.9, 2.2)]</td>
<td>(2.2 \text{ or higher})</td>
</tr>
<tr>
<td>Delay time ratio (DTP)</td>
<td>([0,0.3)]</td>
<td>([0.3, 0.5)]</td>
<td>([0.5, 0.6)]</td>
<td>([0.6, 0.7)]</td>
<td>([0.7, 1])</td>
</tr>
</tbody>
</table>

*The subsequent judgment or evaluation of traffic congestion situation in this paper is based on the accidental congestion generated under accident conditions.

- **factors influencing the situation of urban road traffic congestion under accident conditions**

In this paper, traffic congestion situation refers to the development situation and distribution state of accidental congestion caused by traffic accidents on the urban road network, including the law of the development of congestion spread, the speed of the spread of congestion on the road and the scope of the spatial impact of congestion. In order to achieve the conditions for the accident prediction and assessment of the urban road traffic congestion situation, it is necessary to influence the crowded situation in the development of related factors and influence mechanism is analyzed, in the subsequent impact on the crowded situation space range prediction and crowded situation severity evaluation in the process of research, related factors or state values, make the research more feasibility and pertinence.

1. accident scenarios

   Accident scenarios include accident nature, severity of loss, duration, occupation of lane, etc.

   According to the accident type, the accident nature can be divided into vehicle collision, scraping, human-vehicle collision, vehicle failure, vehicle collision road fixed facilities, etc. Due to different causes of accidents, the duration and loss of accidents also vary with specific situations. However, the direct consequence of accidents on roads is that the vehicles involved in accidents occupy the lanes for a certain period of time, resulting in the decrease of road utilization rate. In real life, it is generally believed that the greater the severity of the accident, the longer the duration, but it is not absolute. The duration of the accident is also affected by human factors, accident response and processing efficiency. For example, some minor accidents are of low severity and small loss, and the treatment time is supposed to be very short. However, due to the failure of the two parties to reach an agreement on liability determination and other matters, it is difficult to deal with the accident and the recovery of traffic flow is delayed. And some serious accidents, such as damaged vehicles that cannot be restored to use or heavy casualties, if the traffic police department quickly implement a trailer or call 120 for emergency medical treatment, but can remove roadblocks as soon as possible, eliminate the bottleneck.

   In conclusion, the impact of accident scenario on the congestion situation is fundamentally reflected in the reduction of road capacity caused by the accident and the duration of the state of traffic capacity reduction.

2. real-time traffic environment
Real-time traffic environment in the process of handling the accident may also affect road congestion, traffic environment here mainly refers to the period of road accident itself running status, the length of the road traffic flow upstream traffic demand change, and duration of accident, accident point surrounding road network node density, associated sections or parallel replace sections of the residual capacity and so on.

If the traffic accident is located at a key node of the road network, or happens at the peak travel time, the road operation state of the accident is already "at risk", the accident will undoubtedly lead to the traffic state "worse", it is easy to cause mixed congestion, its situation development is more complex, control or evacuation is more difficult; If in the congestion control or evacuation stage, there are relatively more nodes available for diversion in the road network around the accident point and sections meeting the diversion conditions, it will undoubtedly reduce the development momentum of the congestion situation or accelerate the dissipation process of the congestion situation, and reduce its impact on the road network traffic.

3. class of road and location of accident

Expressway has the characteristics similar to expressway. When it intersects with other grade urban roads, it mostly adopts three-dimensional intersection, and the interchange spacing is large. When accidents occur in expressway sections and cause accidental congestion, the direction of congestion diffusion is opposite to the direction of traffic flow, and there is less interference at the intersection, so congestion spreads linearly on all sections. When an accident occurs on the off-ramp of an expressway, depending on the location, it may cause congestion on both the ramp and the main road.

Trunk roads occupy an important proportion in urban roads because of their positioning and functions, and their speeds are greatly affected by intersections. When there is an accident in the main road section, the congestion spreads in reverse along the traffic flow. The longer the length of the road section, the farther the location is from the upstream intersection, and the slower the congestion spreads. When the accident occurs at the entrance and exit of the main road intersection, it will directly affect the vehicles entering or leaving the intersection in all directions, and the congestion will spread in all directions through the intersection. At the same time, the capacity of the plane intersection on the main road is obviously lower than that of the road section, and most intersections are mostly controlled by signals, so the diffusion direction and duration of congestion are closely related to signal control, and the upward diffusion of all sides of the crowded intersection generally exists in sequence.

The diffusion of sporadic congestion on the secondary trunk road and branch road in the city also has similar spatial divergence characteristics. However, because many intersections on the secondary trunk road and branch road are not controlled by signal lights, the diffusion direction of congestion is more rapid and disorderly, and the divergence is more obvious, and evacuation is more difficult.

As the main frame and passageway of urban road network, the development of occasional congestion on urban main road is very important for the overall operation of urban traffic system. For this paper, the congestion situation under accident conditions is set to occur in the main road section.

4. road network configuration

The layout of urban transportation network in China is mainly square format, radial ring type, free type and comprehensive type. The difference of road network structure shape determines the difference of spatial distribution, connection form and other states of nodes and sections in the road network, affects the operation organization of road traffic flow on it, and also affects the abnormal traffic state of traffic congestion. Specifically, the layout of road network will affect the scale of congestion, the speed and mode of congestion diffusion and so on.

Some scholars used CTM model to study the congestion characteristics of radial road network based on small-scale regular road network. The results showed that radial ring road network was more likely to produce traffic congestion and crowded closed loop than grid road network. When the traffic load of road network increases, the growth rate of square road network congestion scale is higher than that of radial ring. Moreover, the maximum congestion size of the square road network increases linearly with the traffic demand at first and then tends to be flat, and the change trend of radial ring road network presents an "S" shape (Liu, 2013).
In view of the square road network is the basic composition form of most urban road systems in China, this paper selects the square road network as the research basis when studying the congestion situation under accident conditions.

5. subjective driving behavior

The essence of accidental congestion caused by traffic accidents is that accidents occupying lanes lead to the reduction of traffic capacity of the accident section, resulting in the queue delay of upstream vehicles. Vehicles running on the road are the main part of the queue, and their subjective driving behaviors will also affect the development of the crowded situation.

For example, on the macro level, vehicles farther upstream from the accident site may re-select the route when they know in advance that the road ahead is crowded, so as to complete the automatic diversion of vehicles and reduce the traffic demand at the upstream of the accident site, which is conducive to reducing the degree of congestion. At the micro level, the upstream close section in the bottleneck of the motion of the vehicle state affected by vehicle lane-changing behavior, especially when the rest of the lanes of traffic at the speed of similar saturation flow rate through, if the upstream traffic lane changing frequently, the neck of the actual flow will be reduction, namely the same time by the number of vehicles to reduce bottleneck, queuing delay, congestion will be more serious(Zhang, 2014).

In this paper, when studying the development of road congestion after the accident, the influence of the driver's lane changing behavior on the traffic capacity reduction is considered. And route choice behavior is based on the road the driver awareness ahead of the front road accidents or congestion information and the spontaneous change path, subjectivity and randomness, is more of the induced traffic jams dissipation process or control measures of intervention under the condition of impact on the running state of the network, to ensure that the research focus, this paper then explores its subsequent temporarily not for path selection.

- basic scenario setting of the paper

Generally speaking, the occurrence of urban road traffic accidents will lead to the occupation of road lanes in the period of accident treatment and recovery, the reduction of traffic capacity at the accident site, the need for the upstream vehicles to slow down and change lanes when they continue to enter the accident area, and the reduction of traffic efficiency at the road section.”, however, once the accident that caused the primary crowded even trigger further upstream network secondary crowded "this claim is not rigorous, as discussed before, the content of the emergence and development of primary and secondary crowded conditions, traffic environment will be affected by accident, the accident location, the influence of many factors such as the road level. Therefore, before studying the road congestion situation under accident conditions, it is necessary to consider various influencing factors and judge whether the primary congestion caused by traffic accidents will cause secondary congestion in the surrounding road network, which is the premise of studying the development of congestion situation. Different from the accident location, it is believed that road traffic accidents cause secondary congestion, as shown in table 3.

Table 3 discriminant conditions of secondary congestion caused by traffic accidents in different locations

<table>
<thead>
<tr>
<th>Highway grade</th>
<th>Accident location</th>
<th>Criteria for secondary crowding caused by accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Express-way</td>
<td>Entrance and exit road section</td>
<td>Congestion spreads to the nearest ramp entrance Congestion spreads to the main road</td>
</tr>
<tr>
<td></td>
<td>Intersections (including entrances and exits in all directions and the central area of the intersection)</td>
<td>Congestion spreads to the nearest signal-control intersection</td>
</tr>
<tr>
<td>Main road</td>
<td></td>
<td>Congestion spreads to the nearest intersection upstream in either direction of diffusion</td>
</tr>
</tbody>
</table>

With the development of advanced technology of traffic detection equipment and the research progress of traffic condition discrimination algorithm, it is feasible to detect traffic accidents and...
identify road traffic congestion status in real time. Later in this chapter the accident under the condition of road congestion situation forecast and evaluation of related research based on the premise of accident severity can cause secondary crowded, at the same time, in view of the accident under the condition of urban road congestion situation factors affecting variety and complicated, it is necessary to further clear, the thesis studies the basic situation as shown in table 4.

Table 4 basic scenario Settings based on factors influencing the accident congestion situation

<table>
<thead>
<tr>
<th>Factors affecting the accident congestion situation</th>
<th>The specific situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The accident scene</td>
<td>The accident occupies at least one lane, the duration increases with the severity of the accident, and the accident handling efficiency is at a normal level, regardless of the delay of the accident handling process caused by human factors.</td>
</tr>
<tr>
<td>Real-time traffic environment</td>
<td>The traffic flow at the time of the accident reached the general level in the daily life of the accident period, and the traffic demand at the upstream of the accident point did not change abruptly during the duration of the accident treatment.</td>
</tr>
<tr>
<td>The class of the road and the location of the accident</td>
<td>The traffic accident happened on the main road in the city.</td>
</tr>
<tr>
<td>Network configuration</td>
<td>The basic grid primary and secondary trunk road network, the road spacing take the urban main road reasonable spacing value of 700-1200 meters, the intersection of connecting sections are adopted signal control, the road two-way traffic, the intersection inlet three direction diversion.</td>
</tr>
<tr>
<td>Subjective driving behavior</td>
<td>After the accident, the influence of the driver's behavior of changing lanes in the accident section is considered.</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

This paper mainly writes about the prediction and evaluation of urban main road congestion situation under accident conditions. By doing literature review, this paper indicates the crowding and spreading mechanism under the accident conditions and the factors affecting the development of road congestion.

For further study, the mechanism of crowding occurrence and spread under urban road accident conditions should be analyzed. In addition, from this review, Based on traffic wave theory and Van Aerde model combined with the influencing factors, congestion can be built according to urban trunk road traffic function and traffic flow characteristics. Due to the limitation of personal ability and knowledge structure, and the relatively short research time and lack of relevant actual traffic data, this paper still has shortcomings in research methods and need to do further research by more quantitative methods. The next step of study is to analyse in a specific study area and predict Influencing Range of main road congestion situation.

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