Rail Transport into the Network under Fault Propagation Delay Mechanism and Dissipative Control Method

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Abstract - How quickly and accurately implement fault disposal to alleviate the impact of failures on the system when failure occurs in urban rail transit case; fast recovery system uptime and maintaining operational security for the duration of the event to the incident as possible to minimize losses limit has become network operation under conditions of urban rail transportation emergency management field major problems to be solved urgently.

Index Terms - rail transport, delay mechanism, dissipative control method

1. Introduction

Current urban rail transport in China has entered a period of rapid development, and many major cities' rail transport system is gradually moving in the direction of the development of the network, the network process, along with a lot of new technology, new equipment intensive put into use, operation and management methods multi-line integrated operation management to change the direction of the formation of rail transportation network operation situation [1-2]. However, to achieve this leap and change at the same time, domestic and international rail traffic as emergency dispatch policy mistakes led to major security incidents has become increasingly prominent: on February 18, 2003, Daegu subway fire accident resulted in 198 deaths, and 146 people were injured, resulting in property losses of up to 4.7 billion won; on December 22, 2009, Shanghai train collision accident led to the surrounding road traffic paralyzed, 105 buses transported six hours before the evacuation even lag passengers; on September 27, 2011, Shanghai train rear-end accident resulted in 260 injured. These series of major accidents in the world have aroused strong social repercussions. How to fix a net operating conditions, rail transportation system fault propagation delays, rapid relief of failure, failure on the rail transport system to reduce the impact of rail transport sector has become widespread concern.

After the failure of rail transport emergency involving a wide range of large amount of information, with high, rapid response, emergency response capabilities for management and put forward high requirements. And because rail transport in urban passenger transport systems assume a high volume of important functional orientation backbone transport, rail transport incidents will not only lead to the transfer station to pass along a large passenger mutations, the network service level dips such problems within the system, and may leading to the city within the local area road traffic system service level volatility and even casualties, property damage and adverse social impacts and other serious consequences. Failure occurred in urban rail transit case how quickly and accurately implement fault disposal to alleviate the impact of failures on the system, fast recovery system uptime and maintain operational security for the duration of the event to the incident as possible to minimize losses limit has become network operation under conditions of urban rail transportation emergency management field solved major problems. And rely solely on existing management methods and tools have been difficult to solve this problem, the characteristics of the fault must engage in a more in-depth research. To do this, you first need the characteristics of various faults and fault analysis of the situation, in-depth understanding of rail transportation network performance and traffic distribution changes, on the basis of a scientific and reasonable to deal with emergencies.

Urban rail transit failure mechanism of propagation delays for rail transportation network is a complex network characteristics, network topology, and combined operations that occur during different nature of the failure and its impact on the rail network nodes and edge occurs after a fault propagation theory in-depth analysis, and proposed based on complex network theory dissipative rail traffic congestion control strategy.

Urban rail transit delay fault propagation mechanism and delays dissipative control strategy will greatly enhance the operational management of urban rail transit safety standards, improve the urban rail transportation security system, improve the rail transport operations carried out during the incidents rapid response and the ability to timely and effective treatment, greatly reducing accidents caused casualties and property losses, for the social and economic functioning to provide a strong transportation security. In the current urban rail transit period in China to develop, carry out this research work has a very important theoretical and practical significance.

2. Urban Rail Transit Network Characteristics of Complex Networks

Abroad, Latora and Marchiori [3] on the Boston subway network characteristics were studied, opened the complex network of rail transportation apex; Since then, many foreign scholars on a complex network of rail transport characteristics were studied. Infancy largely confirmatory studies confirmed the rail network of the small world features, such as: Sen, etc. [4] studied the Indian Railways network, small-world

characteristics; Jiang and Claramunt [5] on urban street networks were studied, exemplifies this network has small-world characteristics; Seaton [6] and other detailed calculations of the two cities, Boston and Vienna railway line network of small-world effect; since then, scholars of the rail transport network characteristics and topology further depth, Sienkiewicz [6] analyzed the Polish 21 the city's public transport network topology characteristics, and then, further analysis of the Polish urban public transport network clustering coefficient, matching and referral numbers and other characteristics; Angeloudis [7] on the World subway network complexity were studied.

Urban transport network for the domestic aspects of complexity research has just begun to study earlier that Beijing Jiaotong University, GAO Zi , Wu Jianjun , etc., their transportation field theory of a complex network of empirical research carried out by constructing OD Network studied the urban public transport network characteristics and scale- index distribution and transportation network as an example of Beijing completed a case study; later scholars on this basis for further in-depth , complex transportation network topology and other characteristics studied , Zhao Jinshanthe use of complex networks research methods established for the Beijing bus transport bus lines, bus transfer and docking site and other complex networks to discuss the geometric properties of the Beijing public transport network , also revealed the point of the public transport network with the right distribution network is different from other weight distribution point right in nature: Li Ying, Zhou et al in Shanghai bus transportation system docking site network as the research object, its complexity analyzes, and calculate the degree distribution, average path length, clustering coefficient and other indicators, and tested the network in random failures and selective attack case invulnerability .

The study showed that, including rail transportation network, including the transport network is a typical scale-free complex networks, which have the characteristics of priority connections and continues to grow, the node distribution follows a power law, so there is a small amount of the network has a large number of connections "pivot point" has a small amount of the simultaneous existence of a large number of connected nodes. The scale-free network against unexpected failures has amazing strength and toughness, being "random removal of" undermining mainly those who only have a small number of nodes linked unimportant, random removal of certain traffic node does not cause paralysis of the entire transport network, but If deliberate on traffic "choke points" to attack and damage, it will quickly lead to paralysis of the entire network. This feature is essentially derived from these non-homogeneous complex network topology, these analyzes based on complex network theory greatly improving the transport network reliability and robustness of scientific understanding. Therefore, the urban rail transit network characteristics must be based on in-depth analysis based on the theory of complex networks.

For transportation network into a complex network characteristics, domestic scholars gives the complex network connectivity, a new measure, and on this basis, given invulnerability measure the new definition. In this study, based on some scholars began to survivability analysis and optimization of two aspects of invulnerability detailed overview of current domestic and international complex network invulnerability progress of the study. As the particularity of urban rail transit network, there is only on the part of domestic and urban rail transport network characteristics of small world, and for rail transportation network fault delay propagation and dissipation methods research is still in its infancy, an urgent need for complex network theory perspective of its reliability problems, which deal with the prevention and disposal of urban rail transit network disasters and terrorist attacks, preparedness for the rail network was coordinated attack and destruction, improving rail transportation network reliability, service quality and attractiveness and so has a very important theoretical and practical significance.

3. Urban Rail Transit Fault Delay Dissemination of Research

Rail transport organization scheme will be the station , line, signaling equipment and passenger demand , and many other factors, due to the daily operation of trains Passenger drop , equipment failures and unexpected events of cause delays. Train fault occurrence is random delays, coupled with well -borne, will form a joint and several train delays. Urban rail transit system has a train running interval is small, the short distance between stations, station line layout is relatively simple features, in the event of failure delayed trains, and its propagation range, the ability to cause serious losses. Therefore, the study of urban rail transit train fault generation and propagation delays affect the operation of organizations to determine a reasonable solution to improve the capacity and operational reliability, adaptability is very important. For train delays in the field of railway transport, there are many scholars studied, and the formation of a greater amount of research. In urban rail transit train delays research, some scholars studied occurred when the train is technically realized how late run adjustments, but the delay is not the fault of in-depth analysis. Delays occurred due to a failure randomness, its spread also by train diagram predetermined time control, overall, the fault occurrence and propagation delays with "random have control " feature, so quantitative analysis and research difficult. General urban rail transit system train fault propagation delays and quantitative study of impact depends on the simulation software simulation.

4. Problems

Rail traffic congestion caused by failure problem is a dynamic rail traffic flow redistribution important part, which contains very complex information. This information is of great importance for people to correctly understand and grasp the generation of rail traffic congestion, evolution, transfer, diffusion law, especially important for rail traffic dispatching emergency personnel. However, the current rail traffic congestion fault propagation mechanism and methods of

dissipation exist following deficiencies:

1) lack of an effective model for describing fault propagation mechanism rail traffic;

2) cannot effectively describe the rail transport road network congestion propagation dynamics;

3) has not yet formed an effective fault delay dissipative control strategy.

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