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Development and Application of a Traffic Governance Model in Huangpu District, Guangzhou

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Abstract: Traffic governance models are effective tools for refined decision-making analysis of traffic operations and serve as vital platforms for enabling collaborative governance among multiple stakeholders. By assessing the core distinctions between transportation planning models and traffic governance models, this paper presents a technical architecture for the traffic governance model system in Huangpu District, Guangzhou, based on a closed-loop logic of data perception, model simulation, governance decision-making, and data re-perception. The integrated macro-meso-micro traffic governance model can enable a tiered and coordinated simulation of urban transportation development. Its typical application scenarios include road traffic operation monitoring and dynamic governance, decision support for traffic management, congestion point governance and decision analysis, and full-process governance of traffic engineering projects. Empirical research demonstrates the model's significant contribution in improving traffic governance efficiency: the macro-level model achieves daily variation monitoring of saturation levels across the entire road network and accurately identifies the spatiotemporal distribution of highly saturated intersections; the meso-level model effectively simulates the dynamic evolution of congestion caused by road occupation for construction; and the micro-level model provides lane-level validation and evaluation of traffic organization plans' impact on road operations. **DOI:** 10.13813/j.cn11-5141/u.2025.0029-en

Keywords: transportation planning; traffic governance model; integrated macro-meso-micro approach; congestion governance; Huangpu District, Guangzhou

0 Introduction

In the latter half of urbanization development, major cities in China are generally transitioning from incremental planning to stock-based operation. The goal of transportation development is shifting from "ensuring access" to "ensuring quality", making urban traffic governance an inevitable choice. Urban traffic governance is characterized by interdisciplinary integration, multimodal coordination, multi-stakeholder complexity, and high technical precision. It involves not only planning-oriented governance but also operation-oriented governance.

Wang et al. [1–2] regarded the integrated macro-meso-micro approach and the urban traffic governance integration platform as core technical approaches within the theoretical framework of modern urban traffic governance. For a long time, research on urban traffic models both in China and abroad has primarily focused on planning decision support models [3–5]. However, such models fall short in addressing the needs of traffic governance in the stock-based operation phase, where governance must be diversified, efficient, accurate, and involve multiple stakeholders [6–9]. The main limitations include the following: 1) Although model data sources have evolved from small-scale sample surveys to the integration of massive multi-source data, the service orientation still centers on supporting major planning studies and project construction, with service recipients largely limited to government agencies. 2) The model architectures remain isolated, with macro-, meso-, and micro-level models often developed independently, making it difficult to support multi-scenario governance across different spatial scales during the stock-based operation phase. 3) The modeling process typically involves coarse granularity in aspects such as traffic zoning and road network structuring, resulting in insufficient refinement in model outputs. Breakthroughs in spatiotemporal big data and large-scale modeling technologies have brought new opportunities for the intelligent evolution of traffic governance decision-making [10]. Developing an integrated macro-meso-micro traffic governance model is therefore considered a promising solution.

This paper is grounded in the practical needs of urban traffic governance. By analyzing the fundamental differences between transportation planning models and traffic governance models, we proposed a technical architecture for traffic governance modeling. The applicability of this model

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was then validated through a case study in Huangpu District, Guangzhou.

1 Differences between transportation planning models and traffic governance models

During China’s more than 30 years of rapid urbanization, transportation planning models have provided a scientific means for transportation development posture simulation, policy evaluation, and multi-scenario decision-making analysis in the context of incremental urban expansion. However, limited by the level of early data collection and processing technology, transportation planning models are difficult to adapt to the demand for refined decision-making analysis of transportation operations. With the development of internet technology, traffic modeling technology is becoming more and more advanced, and data collection has made breakthroughs in richness and convenience, making high-precision governance decision-making analysis possible. Based on this, the traffic governance model came into being.

As shown in Fig. 1, there are big differences between the transportation planning model and the traffic governance model in terms of modeling method, application scenarios, and logical architecture. The main application scenario of the transportation planning model is the matching analysis of facility supply capacity and demand in the incremental planning stage, based on the trend study for planning simulation, and the logic of its thinking is the growth of traffic demand brought about by the expansion of urban scale under the goal orientation, and the growth of traffic demand to support the expansion of the facility supply to form a chain of analytical ideas; while the traffic governance model emphasizes enhancing the operational efficiency of transportation facilities during the stock operation phase. Its analytical logic is based on data-driven user profiling, enabling the precise alignment of transportation facility operations with user needs. This approach fosters integrated operation and service coordination of transportation facilities, ultimately leading to the continuous and dynamic optimization of user profiles through new data generated by service coordination.

Moreover, the primary distinction between the traffic governance model and the transportation planning model lies in the level of modeling granularity. This is evident in two key aspects: Firstly, the traffic zoning is elevated from the block level to the parcel level. While the transportation planning model focuses on matching supply and demand, where block-level zoning suffices for analytical precision and computational efficiency, the traffic governance model concentrates on the operation of existing facilities. Block-level zoning can lead to traffic concentration in certain local segments, resulting in a distorted spatial distribution of traffic volumes that fails to meet decision-making requirements. Therefore, traffic zoning needs to be refined to the parcel level. Secondly, the modeling of road networks has become more refined. Transportation planning models emphasize the connectivity of the road network structure (Fig. 2a), whereas traffic governance models require a high degree of alignment with the actual operational road network. This necessitates a more detailed representation of weaving, merging, and diverging segments (Fig. 2b). For example, in the current model of Guangzhou, the scale of the road network and the number of key operational indicators in the traffic governance model have increased by 1 to 3 times compared with those of the transportation planning model (Table 1).

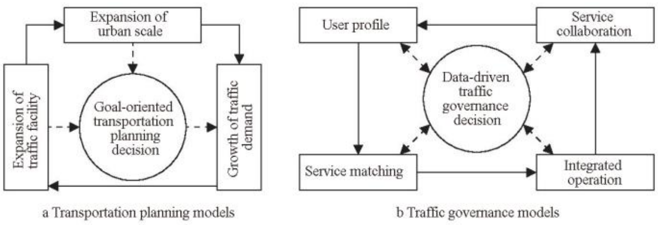


Fig. 1 Decision-making logic of transportation planning models and traffic governance models

Fig. 2 Differences in road network modeling between transportation planning models and traffic governance models

Table 1 Comparison of operation model indicators under an identical road network scale in Guangzhou

Key indicator	Transportation planning model	Traffic governance model	Increase ratio/%
Number of road network nodes	15 444	51 851	235.7
Number of road segments	38 936	143 454	268.4
Number of intersection turning movements	108 682	421 864	288.2
Number of traffic zones	1 787	5 225	192.4
Number of traffic zone connectors	10 244	21 160	106.6
Running time of traffic assignment module/s	18	134	644.4

2 Traffic governance model system in Huangpu District, Guangzhou

The traffic governance model is suitable for areas with relatively complete existing traffic networks and heavy traffic pressure. Guangzhou's first traffic governance model was constructed in the Huangpu District. The district is close to the central city, and after decades of rapid development, its transportation facilities (especially the road network) have become relatively complete. In 2024, the average daily traffic volume of the entire network reached 800 000–1000 000 vehicles per day, showing the significant characteristics of high traffic flow on a mature road network. Meanwhile, Huangpu District still has a large number of ongoing transportation infrastructure projects, currently in a period where both new planning and existing operations are at peak levels. The impact of new planning on existing operations is inevitable, thus creating an urgent practical need for urban traffic governance.

2.1 Technical architecture

Based on the closed-loop logic of data perception, model simulation, governance decision-making, and data re-perception, the technical architecture of the traffic governance model for Huangpu District, Guangzhou (Fig. 3) was constructed, including the data layer, model layer, display layer, and application layer. The data layer uses multi-source data fusion technology to perceive the characteristics of people, vehicles, and locations and identify patterns. The model layer develops an integrated macro-meso-micro approach to traffic governance based on the transportation planning model and conducts tiered and coordinated simulations of urban traffic development trends. The display layer outputs the simulation results of the model layer to the data analysis and display management system. The application layer combines typical scenarios to carry out traffic governance decision-making applications. After the implementation of traffic governance decisions, new operational perception data is formed and fed back to the display layer and data layer to form a circular evolution mechanism. This architecture enhances the dynamic adaptability of traffic governance through a closed-loop data system and ensures the scientific nature of decision-making based on traffic governance model simulation. In addition, the display system can also coordinate multiple entities.

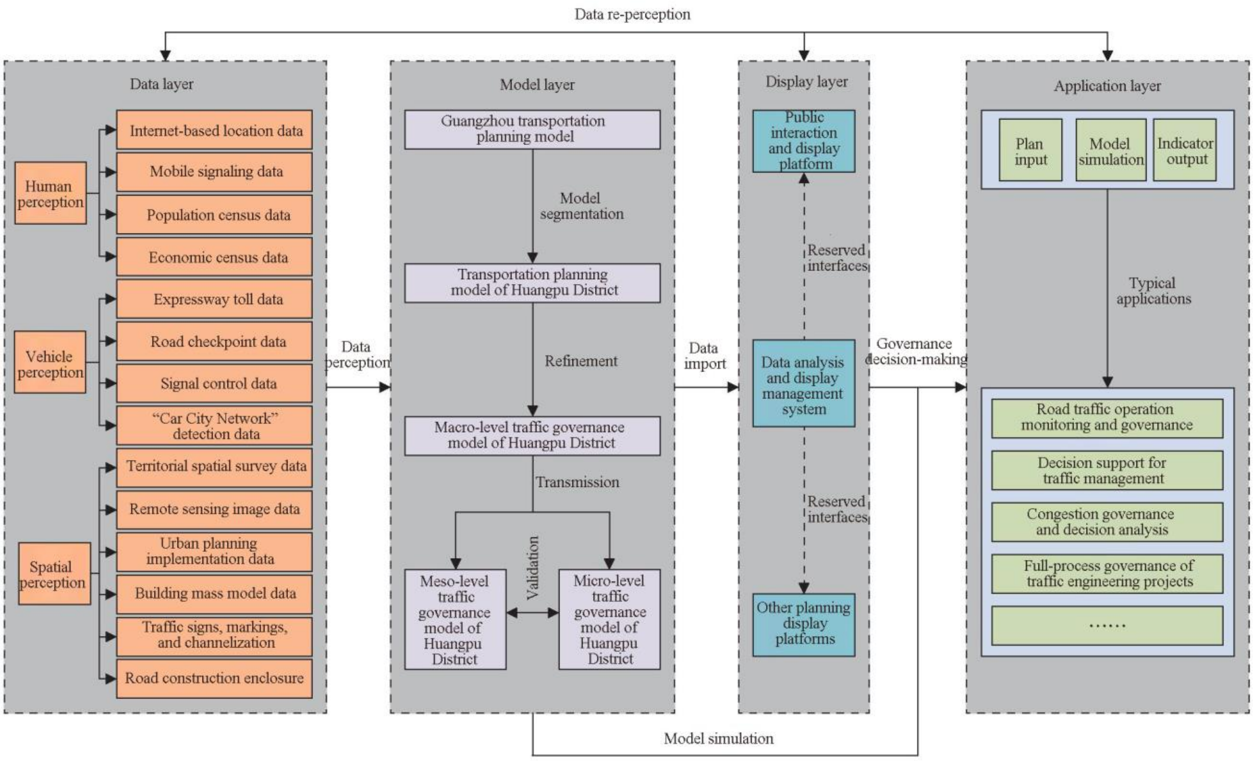


Fig. 3 Technical architecture of the traffic governance model in Huangpu District, Guangzhou

2.2 Data layer

There are significant differences between transportation planning models and traffic governance models in terms of data perception capabilities, mainly reflected in two dimensions: data granularity refinement and road network refinement.

1) As for data granularity, traffic governance models not only rely on basic data in transportation planning models (such as population/job distribution and demand matrices), but also need to refine them into smaller spatial units. The traditional perception data used in transportation planning models (such as mobile phone signaling, expressway tolls, and road traffic checkpoints) is limited by the coverage range of base stations and the layout density of toll stations and road traffic checkpoint facilities. It is necessary to integrate data such as building white models and internet locations to achieve more refined data splitting of spatial units.

2) In terms of refining the road network, take the "Car City Network" platform in Huangpu District, Guangzhou, as an example. Through the deployment of new perception equipment, physical feature data such as road traffic signs and markings, road intersection channelization design, and road construction can be obtained. Based on physical feature perception data, the traffic governance model is used to calibrate the connection between the entrance and exit lanes of road intersections, and parameters such as road section traffic capacity and free-flow speed are refined based on signs, markings, and road construction to provide important support for the construction of an operational road network model.

These differences essentially reflect a paradigm shift from transportation planning models to traffic governance models, which require the establishment of a more refined data collection system and more complete road network representation capabilities. The adaptability of various types of people, vehicle, and location perception data to transportation planning models and traffic governance models is shown in Table 2.

Table 2 Data types and functions in the traffic governance model of Huangpu District, Guangzhou

	Data type	Analytical scale	Applicable model	Function
Human perception	Internet-based location	Parcel level	Traffic governance models	Fine-scale population/employment distribution and job-housing-travel OD mining
	Mobile signaling	Based on base station coverage, the typical coverage radius is 300–500 m.	Transportation planning models	Medium-scale population/employment distribution and job-housing-travel OD mining
	Population census	Community/village level	Transportation planning models	Medium-scale population distribution
	Economic census	Community/village level	Transportation planning models	Medium-scale employment distribution
Vehicle perception	Expressway toll	Based on toll station distribution, the zone scale is approximately 30–50 km^2	Transportation planning models	Provide base OD matrix for vehicle flow
	Road checkpoint	Based on checkpoint distribution, the typical zone scale is 1 km^2	Transportation planning models	Provide base OD matrix for vehicle flow
	Signal control	Green light release time per traffic movement at intersection	Traffic governance models	Basic data
	"Car City Network" detection	Traffic volume per movement at intersection	Traffic governance models	Model calibration
Spatial perception	Territorial spatial survey	Parcel-level land use feature	Transportation planning models Traffic governance models	Traffic-zone aggregated land-use data for traffic planning models parcel-level data support traffic governance model development
	Remote sensing image	Typically used for medium-scale fuzzy analysis	Transportation planning models	Assist land-use data analysis
	Urban planning implementation	Parcel level	Transportation planning models Traffic governance models	Traffic-zone aggregated land-use data for traffic planning models parcel-level data support traffic governance model development
	Building mass model	Parcel level	Traffic governance models	Support model development, especially for disaggregating planning model data to fine-scale population/employment/travel OD using building volume
	Road markings and channelization	Detailed perception of road traffic supply conditions	Traffic governance models	Road network refinement
	Construction enclosure	Detailed perception of road traffic supply conditions	Traffic governance models	Road network refinement

2.3 Model layer

An integrated macro-meso-micro approach to traffic governance modeling has been developed, with a tiered and coordinated simulation model to meet the decision-making needs of different levels. The macro-level traffic governance model uses static numerical simulation to support traffic operation monitoring and governance, effectiveness evaluation of traffic management policies, etc. The meso-level traffic governance model focuses on vehicle fleets, with rapid response capabilities and the ability to simulate large traffic flows, providing dynamic simulation services for congestion point governance and decision-making analysis. The micro-level traffic governance model focuses on individual vehicles, has higher simulation accuracy, and provides decision-making support for the full-process governance of road traffic transformation. Layered modeling maintains the functional independence of each level of the model while achieving vertical coordination through data interfaces, providing a systematic decision-making support tool for traffic governance.

2.3.1 Macro-level traffic governance model

The macro-level traffic governance model is constructed based on the structure of the transportation planning model and includes 10 functional modules: passenger car ownership prediction, population prediction, network cost calculation (used to assess the generalized travel costs in the traffic network), integrated model for travel generation, distribution, and mode split, time-segmented and load factor analysis, bicycle traffic allocation, car traffic allocation, truck traffic allocation, public transportation allocation, and OD backcasting. The model has the ability to analyze multiple modes of transportation in an integrated manner.

The macro-level traffic governance model significantly improves simulation accuracy through refined road network construction and distribution methods, specifically manifested in the following ways: 1) cross-classification based on road grade, free-flow speed, main and auxiliary lane configuration, median strip settings, non-motorized vehicle and pedestrian traffic restrictions, and other factors, with a total of 77 road types set; 2) refining the network topology to closely match the actual road network; 3) refining traffic zone divisions and considering capacity restrictions on entry and exit lanes of traffic zones (Fig. 4); 4) aligning and matching the entry and exit lanes of key road intersections (Fig. 5); 5) adopting a traffic distribution method based on intersection capacity analysis.

2.3.2 Meso-level traffic governance model

Based on the transmission mechanism of the macro-level traffic governance model, relying on the basic model road network and travel demand data, and supported by the road and traffic environment perception data of the “Car City Network” in Huangpu District, Guangzhou, a meso-level traffic governance model for a 100 km^2 core area was developed using DYNAMEQ mesoscopic simulation software (Fig. 6).

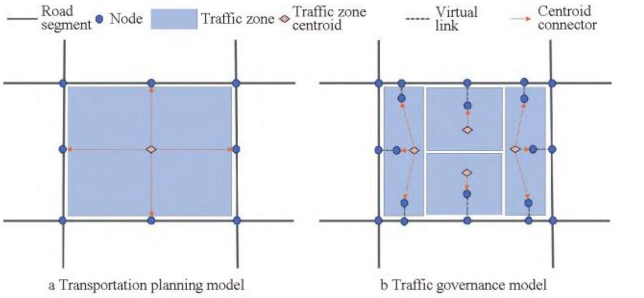


Fig. 4 Comparison of zoning refinement and connected-line configuration between macro-level traffic governance models and transportation planning models

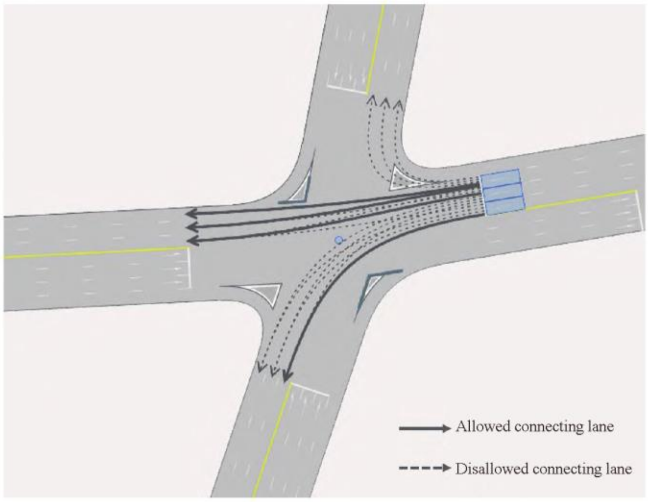


Fig. 5 Lane alignment registration of entry and exit points at intersections in the macro-level traffic governance model

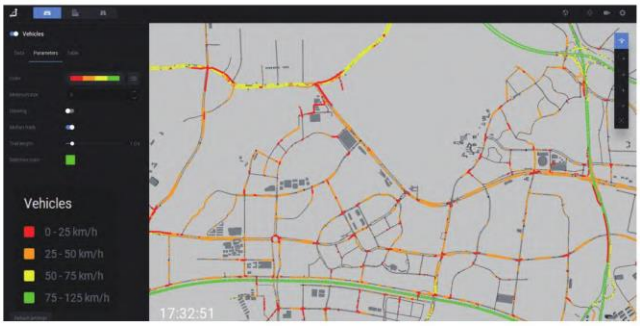


Fig. 6 Interface of the meso-level traffic governance model in Huangpu District, Guangzhou

This model can evaluate both time and space dimensions: 1) In terms of time, it breaks through the limitations of peak hour analysis in macro-level traffic governance models and can output simulation indicators at fine-grained time intervals such as 5 and 15 min. 2) In terms of space, it supports multi-scale evaluation from the overall road network to specific paths, road sections, and nodes.

Through multiple indicators such as traffic flow speed, traffic density, vehicle delay time, road occupancy rate, road section or node congestion time and distance, and especially the visual representation of the model simulation speed contour map, the meso-level traffic governance model can not only identify congested road sections, but also accurately depict the spatiotemporal evolution mechanism of congestion. As shown in Fig. 7, for traffic impacts caused by road construction, the model successfully recreated the congestion dynamics of a specific section from 17:20 to 18:55, fully presenting the entire cycle characteristics of congestion onset (17:20), peak spread (18:10), and dissipation (18:55). This dynamic simulation capability provides a quantitative basis and intuitive dynamic display for decision-making on lane control, construction traffic organization, and traffic congestion governance.

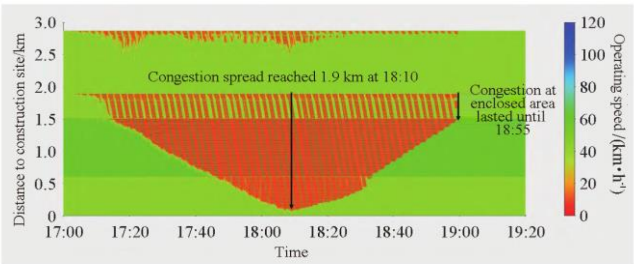


Fig. 7 Simulated speed isolines for a selected road segment using the meso-level traffic governance model in Huangpu District, Guangzhou

2.3.3 Micro-level traffic governance model

Based on the transmission mechanism of the macro- and meso-level traffic governance models, VISSIM simulation software was used to construct a micro-level traffic governance model for three areas in Huangpu District: Knowledge Town, Science Town, and the old town (with a total area of approximately 120 km^2). Relying on VISSIM simulation software, this model has the following functional characteristics: 1) evaluation function for the entire road network and single road sections/nodes; 2) integrated multi-indicator evaluation capabilities (including vehicle travel speed, traffic density, traffic volume, and motor vehicle pollutant emissions); 3) support for maximum, minimum, and average values across multiple statistical periods (current time, any time period, and peak hours) and different simulation runs; 4) evaluation at different scales (including different lanes at a specific cross-section location, or different segments of a road section) (Fig. 8).

The micro-level traffic governance model can support the refined traffic governance needs of Huangpu District in the context of existing construction, and is suitable for refined comparison and simulation of road engineering design plans, refined impact analysis of road occupation during construction, etc. The model can provide technical support for plan decision-making and significantly improve the scientific level of traffic facility construction.

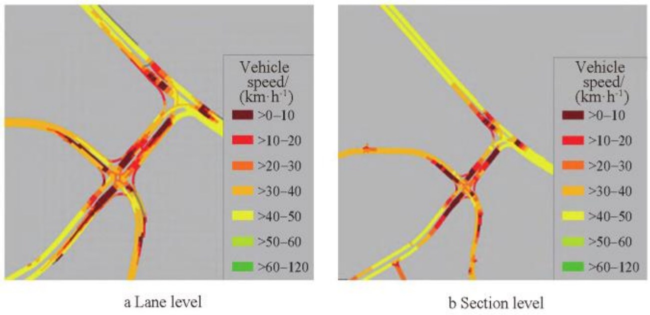


Fig. 8 Simulated speed distributions at different scales using the micro-level traffic governance model in Huangpu District, Guangzhou

2.4 Display layer

The core of traffic governance lies in coordinating the interests of multiple stakeholders. A traffic governance model must rely on an intuitive and accessible data analysis and display management system to support multi-stakeholder interaction (Fig. 9). This system is built around three functional modules:

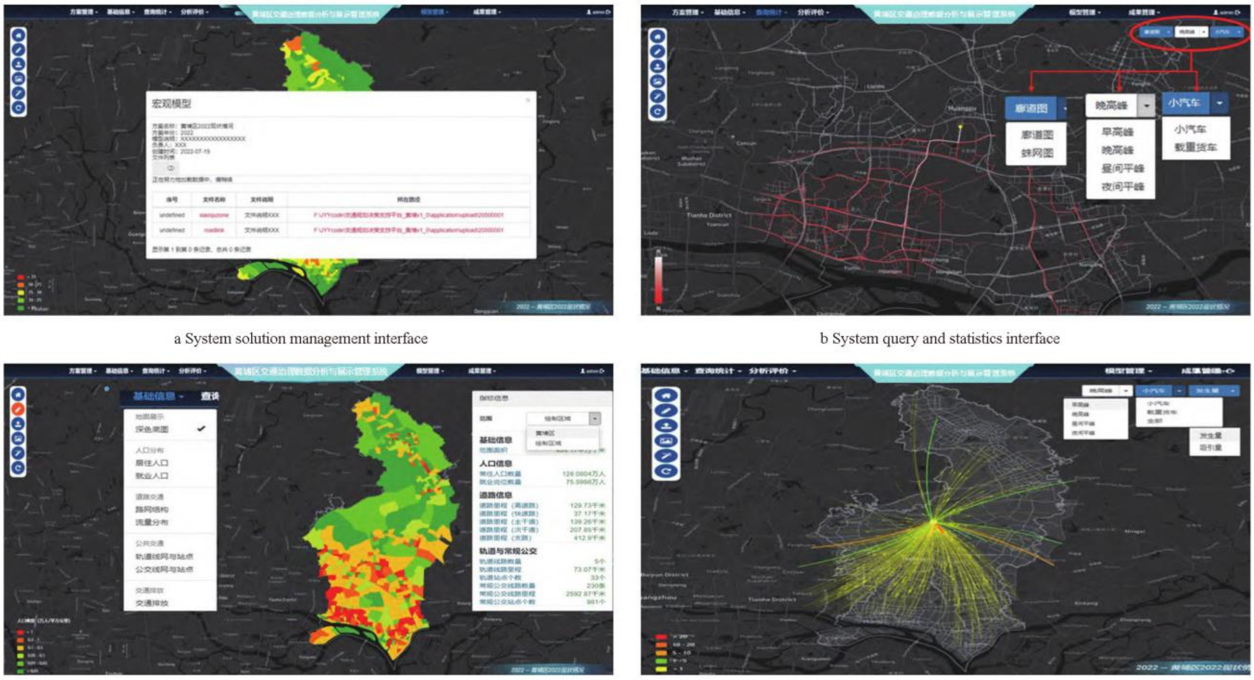
1) Data statistics analysis and display module: This module integrates information query, statistics, and analysis and evaluation modules to support one-click queries by administrative departments, scientific analysis by professional institutions, and public interaction. It provides three operation modes: regional indicator overview, regional selection query, and random display on mouse hover. It focuses on population coverage analysis, public transportation accessibility evaluation, urban rail transit station coverage analysis, and road network load assessment to provide strong support for transportation governance decision-making.

2) Project management module: It can realize the full process recording and archiving of governance projects.

3) Scheme management module: It can support multi-scheme comparison, model file management, and dynamic maintenance of decision-making results for individual governance projects, realizing traceability and continuous optimization of the governance process. The system design takes into account the efficiency and convenience of administrative decision-making, the technical needs of professional institutions, and the ease of use for public participation, while adapting to the complex dynamic characteristics of traffic governance and providing a digital support platform for multi-subject collaborative decision-making.

2.5 Application layer

In the current stage of urban development, where incremental construction and existing operations proceed in parallel, urban transportation governance must balance the dual governance requirements of transportation planning and operation. The traffic governance model system has flexible application characteristics: It can be applied through a



a System solution management interface

b System query and statistics interface

c System basic information interface

d System statistical analysis interface

Fig. 9 Interface of the display layer in the traffic governance model in Huangpu District, Guangzhou

single-layer traffic governance model, or via combinatory modes (such as macro-meso, meso-micro, or macro-meso-micro integrated traffic governance models) to suit various governance scenarios, including road traffic operation monitoring and governance, traffic management decision-making support, congestion point governance and decision-making analysis, and full-process governance of road construction projects.

3 Typical applications

3.1 Road traffic operation monitoring and dynamic governance

Based on traffic volume data collected by "Car City Network" perception devices, a macro traffic governance model was used to obtain key indicators of road traffic operation, and road traffic operation was monitored in the form of monthly and quarterly reports to provide three aspects of support for traffic governance decision-making: 1) Road network operation status monitoring: By identifying the proportion distribution of road intersections with high saturation (≥ 0.85), medium saturation (0.6–0.85), and low saturation (< 0.6) (Fig. 10a), the system comprehends the overall traffic operation status, providing a decision-making basis for daily traffic operation management. 2) Analysis of traffic demand characteristics: Based on the daily and hourly variation patterns of traffic volume (Fig. 10b), the system analyzes the traffic demand characteristics of special dates and time periods to assist in the formulation of traffic control contingency plans for special periods. 3) Optimization of traffic resource allocation: By analyzing traffic volume, average delay time, and average queue length at road intersections, the system evaluates the operational status and distribution characteristics of different intersections (Fig. 10c and Fig. 10d), enabling the optimal allocation of enforcement equipment and police resources.

3.2 Decision support for traffic management

In response to the current lack of decision-making support for truck management in traffic governance, we conducted research on the governance of truck violations using a multi-dimensional analysis method based on the data perception, model simulation, and system analysis capabilities of the traffic governance model in Huangpu District, Guangzhou.

First, based on the spatiotemporal distribution characteristics of truck traffic flow simulated by the model and combined with the management policies for truck-restricted road sections and time periods, truck trajectory data was used to accurately identify the distribution of high-frequency prohibited road sections and time periods (Fig. 11). In 2024, high-frequency truck violations in Huangpu District, Guangzhou, were primarily concentrated on sections such as Fengle Road, Zhongshan Avenue, Dashadi East Road, and Guangxin Road. Among these, Fengle Road was the most severely affected section, with an average of 570 violating vehicles per day during restricted periods; high-frequency violation periods were concentrated between 10:00 and 15:00. This analysis provides an important basis for the spatial layout of enforcement

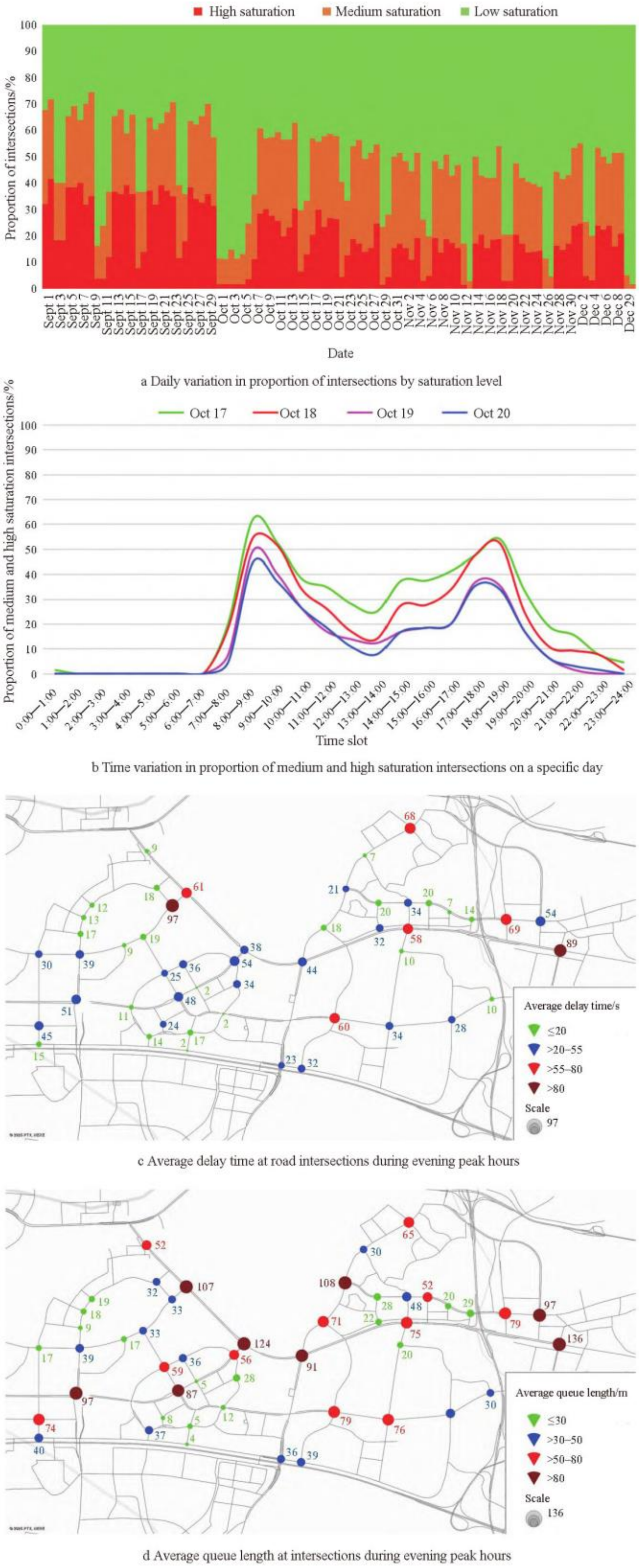


Fig. 10 Road traffic operation monitoring and governance analysis using the traffic governance model in Huangpu District, Guangzhou

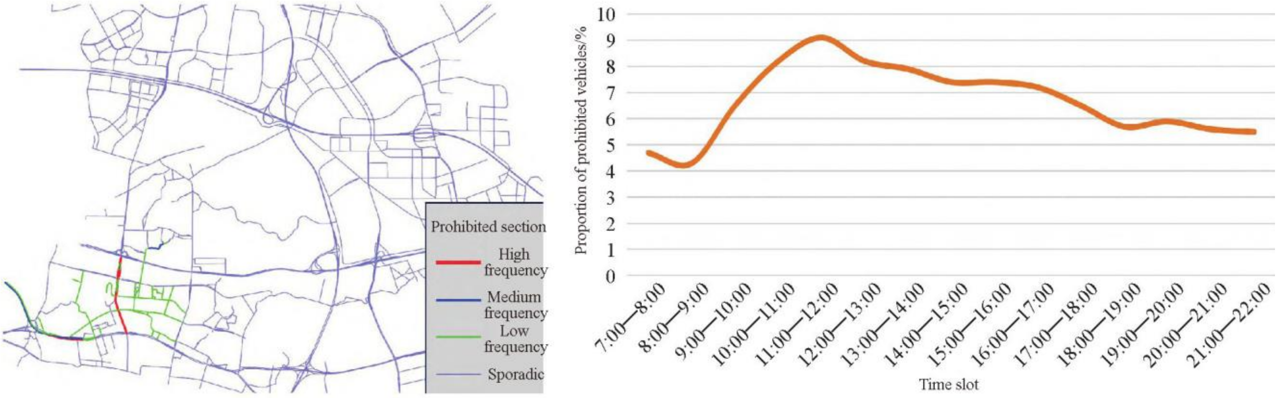
equipment and the precise allocation of enforcement resources in terms of time and space, significantly improving enforcement efficiency.

By further linking truck management information, we can identify high-frequency violation enterprises and drivers. Data shows that in Huangpu District, there are eight freight companies with an average daily violation count exceeding 50, accounting for 0.7% of all freight companies; 35 companies with an average daily violation count exceeding 20, accounting for 3.2% of all freight companies. There were 16 drivers with an average of over 200 violations per month, and 79 drivers with an average of over 100 violations per month. Based on the analysis results, it is recommended that management departments establish a blacklist system for high-frequency violating companies and conduct targeted educational campaigns for high-frequency violating drivers, thereby comprehensively enhancing the effectiveness of truck violation governance and providing a practical pathway for achieving precise and intelligent truck traffic governance.

3.3 Congestion point governance and decision analysis

Based on the traffic governance model of Huangpu District, Guangzhou, a “one point, one policy” governance plan was formulated for each congestion point. Firstly, the traffic flow tracing technology of the macro-level traffic governance model was used to analyze the source and destination distribution characteristics of traffic flow in congested sections. Secondly, a hierarchical control strategy was formulated based on the results of traffic flow tracing: Remote guidance was implemented for regional transit traffic; peripheral diversion was organized for regional entry and exit traffic based on the surrounding road network; and refined traffic design was implemented for the core control area of congestion points. Finally, a meso-level traffic governance model was used to evaluate the effectiveness of diversion and guidance measures, and a micro-level traffic governance model was used to verify the traffic organization plan for the core control area.

In the congestion management of key points such as Fengle North Road and Kaifu Avenue in Huangpu District, scientifically designed remote guidance and peripheral diversion schemes can reduce traffic demand by approximately 10%; micro-level traffic governance model assessments show that reasonable traffic organization can improve node operating efficiency by 20%. Although there are differences in the effectiveness of diversion guidance under different road network conditions, and there are significant differences in the effectiveness of different governance plans, scientific analysis based on traffic governance models can effectively reduce traffic demand at congestion points and improve operating efficiency. This decision-making analysis method helps promote collaboration between planning, construction, and management departments, providing a systematic solution for urban traffic congestion governance.



a Distribution of prohibited sections

b Distribution of prohibition time periods

Fig. 11 Analysis of governance of prohibited trucks using the traffic governance model in Huangpu District, Guangzhou

3.4 Full-process governance of traffic engineering projects

The traffic governance model is not only applicable to the operation and governance of existing facilities, but also provides full-process decision support for the construction of incremental facilities. Specifically, the macro-level traffic governance model can effectively judge the adaptability of the construction scale, scientifically assess the degree of matching between the construction project and future traffic demand, and provide an important basis for determining a reasonable construction scale. The meso-level traffic governance model focuses on assessing the possible impact of construction projects on existing facilities in the region and supports the comparison of construction plans from the perspective of system optimization. On the one hand, the micro-level traffic governance model can conduct detailed comparisons of construction project design plans, and from the perspective of traffic organization, it can conduct an in-depth analysis of the suitability of design plans for the functional distribution of main and auxiliary lanes, the organization of merging and diverging traffic, and the intertwined operation of vehicles. On the other hand, it can conduct dynamic monitoring and evaluation of road construction during the construction period and put forward targeted optimization recommendations.

With the Wushan interchange construction project as an example, the macro-level traffic governance model was used to analyze and determine the scale of the construction project (including reasonable cross-sectional scale and turning function configuration), which provided strong support for the joint review and decision-making of the construction plan and planning review. After the scale of the construction was determined, two cross-section forms, “three main lanes + three auxiliary lanes” and “four main lanes + two auxiliary lanes”, were compared for key locations of the project. A meso-level traffic governance model was used to evaluate the impact of different plans on upstream and downstream nodes and their own operational efficiency, which effectively promoted the coordination between the construction management department and the traffic operation management department, and ultimately formed a consistent construction plan. During the construction implementation phase, the micro-level traffic governance model was used to dynamically monitor and evaluate the traffic operation status at the construction site, thereby achieving dynamic optimization of construction traffic organization and ensuring the stability of traffic operation during the construction period. The scientific analysis method of the traffic governance model not only ensures the rationality of the scale of incremental facility construction but also effectively maintains the operational stability of existing facilities, providing a systematic and scientific decision-making support framework for urban transportation infrastructure construction.

4 Conclusions

In response to the practical needs of urban traffic governance during the transition to urbanization, this paper systematically sorted out the differences between transportation planning models and traffic governance models, constructed a technical architecture for traffic governance models, and verified its applicability through empirical research in Huangpu District, Guangzhou. The study found that refined data perception is a fundamental condition for the development of traffic governance models, that the integrated macro-meso-micro traffic governance model is an effective means of meeting the needs of traffic governance decision-making at different spatial scales, and that data analysis and display systems provide an important platform for promoting coordination among multiple stakeholders in the traffic governance process.

As a complex system engineering project, urban traffic governance requires continuous theoretical innovation and practical exploration. This study provides a useful reference for the construction of an intelligent and accurate traffic governance system. However, in the face of the rapidly changing urban traffic governance situation, it is still necessary to continuously improve data perception methods, enrich the construction of traffic behavior feature databases, promote the integrated application of traffic governance models and large model technologies, and continuously improve the digitalization, accuracy, and intelligence of urban traffic governance.

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