Traffic Engineering

Contents

A Traffic Survey Method for Road Intersection Based on UAV Video 11
Application of Improved Walking Index Model in Urban Walking Evaluation 12
GPS-Based Travel Survey Method and Performance Evaluation Considering Key Influence Factors in Practical Application 13
Reconstruction of Living Streets in the Old City Based on PSPL Survey Method-Taking Jingning South Road in Hanbin District of Ankang City as an Example 14
Research on OD Estimation and Transportation Features of Cross-River Pathways in Jiangsu Province 15
Review and Prospect of the Impact of Large Urban Construction Projects on Traffic 16
Analysis for Joint Impact of Various Operation Factors on Streetcars' Travel Time 17
Research on the Scale of Public Bicycle Rental Point Based on Tram Car 18
Analysis of Differential Expressway Toll Scheme of Mianyang- Chengdu -Leshan Economic Corridor 19
Monthly Energy Consumption Forecast of Diesel Bus Based on Time Series Analysis 20
An Effective Strategy to Improve the Accuracy of Individual Travel Mode Detection Based on GPS Data 21
Microscopic Analysis of Behavior Perspective in the Congestion Formation Near Freeway Bottleneck with Three-Phase Theory: Spatiotemporal Study the Vehicle Trajectory Data from Aerial Video in China 22
Highway Evasion Detection and Analysis Based on Improved Fast Peak Clustering Algorithm 23
Detection of Traffic Congestion from Ultra-Low Frame Rate Images Applied in Large Regional Surveillance System via Deep Residual TrafficNet 25
Research on Lane-Level Vehicle Lane Change Strategy Based on NGSIM Data 26
Clustering Analysis of Vehicle Spontaneous Accidents 27
Highway Traffic Volume Prediction Based on Differential Long and Short-Term Memory Networks 29
Research on Grey Relational Grade and Prediction Model of Subway Passenger Flow Quantity 30
Applying Smart Card Data to Estimate and Validate the Destination of Individual Trips in Transit Systems 31
Research on Classification and Recognition of Bus GPS Data Line Based on Machine Learning 32
IC Card Data Based Intelligent Approach to Estimate the Passenger Alighting Stations 33
Trip End Identification Based on Spatial-Temporal Clustering Algorithm Using Smartphone GPS Data 34
Forecasting Method of Seasonal Highway Traffic Based on Improved Wavelet Neural Network 35
The Study of the Relationship Between Traffic Density and Lane-Changing Behaviors in Urban Expressway 36
Path Recognition Method of Urban Rail Passenger Flow Based on Mobile Signaling Data: A Case Study of Nanjing Metro 37

The Pattern of Non-Round Trip Travel on Urban Rail and Its Application in Transit Improvement 38
Research on the Willingness of Parking Sharing in Residential Areas 39
Civil Information Modeling(CIM) Trend in Transportation 40
Analysis of Jiangsu River Crossing Characteristics and Traffic Volume Based on Multi-Source Data Fusion Technology 41
Characteristic Analysis of Highway Section Traffic Flow Based on Toll Data 42
Research on Traffic State Identification of Highway Network Based on DBSCAN Clustering 43
Study on Transportation System of China at the Beginning of the 21st Century 44
Temporal and Spatial Distribution Analysis of Expressway Traffic Flow Based on Toll Data .. 45
Weighting and Expansion Study of Household Travel Survey in Big Data Era 46
Research on Evaluation Criteria of Traffic State in Mountainous Cities Taking Chongqing as an Example 47
Evaluation of Bus Network Connectivity Satisfaction Based on Traveler Selection 48
An Operation Evaluation System for Freeway Network Based on Mobile Big Data 50
Research on The High Speed Railways, Movement of Population and Green Technology Innovation in Enterprise 51
The Taxi Passenger Waiting Time Calculating Model Under Information Condition 52
Study on Evaluation Method and Index System of Green Transport in Small Cities 53
Traffic State Identification Based on Fuzzy Hidden Markov Model 55
Analysis of Urban Public Transportation Development Index Under Big Data Environment . 56
Development and AHP Based Comparison of Bike-Sharing Systems in China 57
Bus Operation Bottleneck Diagnosis Based on Multi-Level Comprehensive Evaluation 58
Study on the Determination of Spatio-Temporal Threshold of Bicycle Connection Rail Transit in Haze Under Traffic Restriction 59
Passenger Satisfaction Evaluation Model of Expressway Service Area Based on SEM 60
Multi-Campus Travel Analysis Based on General Travel Cost 61
Analysis of Influence Factors of Subway Passengers' Mode Choice of Entering Station Based on Logistic Model 62
Research on Residents' Travel Hotspots Based on Taxi GPS Data 63
Research on the Influence of Real-Time Information Based on RP and SP Data on Bus Passenger Path Selection 64
Study on the Choice of Commuting Mode Between Central City and Satellite City 65
Research on Expressway Service Area Design Based on Behavioral Psychology 66
Forecasting Trip Purpose with Social Media Data and Google Places 67
Analysis of the Characteristics of Zhengzhou to Jiaozuo Intercity Passenger Traveling Behavior Based on High-Speed Rail Background 68
Consumer Adoption of Ridesourcing in China Comparison of Consumer Pre-Adoption and Post-Adoption Beliefs 69
Analysis of Influencing Factors of Residents' Travel Mode Based on Decision Tree 70
A Review of Travel Behavior Based on Prospect Theory 71
Investigation and Analysis of Pedestrian Traffic Characteristics at Large Airports in China ... 72
Analysis of Urban Bicycle Travel Choice Behavior Considering the Impact of Walking and Electric Vehicles 73

The Prediction Model and Algorithm for Passenger Flow of High-Speed Railway Based on the Sensitivity Factors Analyzing 74
Travel Characteristics and Traffic Demand Prediction of Tourism Featured Towns Take Hengdian Town as an Example 75
The Development of the City and the Changes of Resident Trip Characteristics in Xi'an 76
Dynamic Life Course Analysis on Household Mobility Decisions 77
Simulation of Urban Passenger Taxi Services' Operation Based on Anylogic Model 78
Exploring the Influence of Family Structure and Built Environment on Household Car Ownership and Usage: A Bayesian Sample Selection Model 79
Study on the Choice of Harbin Residents Travel for Work Based on Logit Model 80
An Ordered Scobit Model with Heterogeneous Loss Attitude: A Study of Commuters' Bus Line Satisfaction 81
Incorporating Multi-Level Taste Heterogeneity in Route Choice Modeling: From Disaggregated Behavior Analysis to Aggregated Network Loading 82
Which Time Variables Can Best Explain People Behavior on Mode Choice a Case Study of Xi'an, China 83
Research on the Vulnerability Assessment Method of Highway Network 84
Domino Algorithm and Application in Shortest Path Optimization 85
Research on the Network Generation Method of Highway and Expressway in Metropolitan Area 86
Parking Network Connectivity Method Based on Attraction Relationship 87
Optimal Locations of En-Route Charging Stations for Electric Vehicles in Congested Transportation Networks 89
Research on Difference Coordination Design of Highway and Urban Road Intersections at Grade 90
Research on the Application of the Idea of Street Sharing in Historic Blocks-Take the Quanyechang Area of Tianjin as an Example 92
Multifunctional Guardrail for Urban Road 93
Shanghai Complete Street Design Practice-Taking the Streets Reconstruction in Caoyang Xincun as an Example 94
Research on U-Turn Mode of Urban Road Intersection Based on VISSIM 95
An Improved Traffic Organization Method for Multi-Road Intersections 96
Height Analysis of Anti-Dazzle Plate in Long-Steep Downgrade Sections of Expressway 97
Research on Urban Expressway Planning Evaluation and Optimization Method for Implementation 98
Modeling Interstation Travel Speed of Hybrid Bus Rapid Transit Within a Bayesian Framework 99
Analysis of Urban Public Transit Dependence Feature 100
Research on BRT Integrated Corridor Design Scheme Based on Bus Travel Delay Analysis 101
Improved Map-Matching Method for Transit Trajectory Reconstruction Based on Transit GPS Data: Case Study in Edmonton, Canada 102
Research on Bus Line Network Optimization Based on Problem Line Screening Model-Taking Suzhou City as an Example 103
Design of Shuangdao Line 4 Station on Hefei Rail Transit Line 4 104

Study on Optimization of Subway Connection Environment Based on Site Classification-Taking Xi'an Subway as an Example 105
Empirical Study on Restriction of Configuring Electric Bus 106
Research on Planning and Implementation of Microbus in Suzhou Industrial Park 107
Optimization Model for Public Transport Timetable with the Time Weight of Transfer Station 108
Comprehensive Analysis on the Robustness of Urban Road Networks 109
Research on Traffic Optimization Design of Round Road Intersections-Taking the Intersection of Yuyang-Shangjun Road in Yulin as an Example 110
Automatic Stochastic Parameter Estimation Method of Macroscopic Traffic Simulation Models 111
Freeway Ramp Controls: Capacity Enhancement and Disruption Probability Analysed by Gap-Acceptance and Queuing Models 112
Traffic Capacity Analysis of Highway Mixed Toll Station Based on Vissim Simulation 113
Analysis on Fundamental Diagram Model for Mixed Traffic Flow with Connected Vehicle Platoons 115
Prediction on the Range of After-Crash Congestion Diffusion Along the Trunk Road 117
The Exploration of Volume Composition Analysis of Expressway Traffic and Evaluation Method Based on Whole Road Section 118
Research on Driver Behavior Decision at Countdown Signal Intersection 119
Research on Optimization of Phases at an Intersection with Asymmetric Traffic Flow 120
Ramp Metering Control Based on Traffic Congestion Source Tracing 121
Contrastive Analysis of Signalized Intersection Period Optimization Model 122
Using Historical Controller Operating Data to Design the Cycle Length and Splits for Signal Coordination 123
Research on One-Way Traffic Organization in the Old Urban Zone - Taking Hexi District of Sanya City as an Example 124
Analysis of the Right-Turn Lane Capacity Under the Influence of Pedestrians 125
Research on Evaluation and Counter Measures of the Integrated Transportation Hubs 126
Traffic Simulation Evaluation of Harbor-Shaped Bus Stops Under the Perspective of Public Transport Priority 127
A Spatiotemporal Analysis on Non-Truck Operating Common Carrier 128
Analysis on Performance and Capital Structure of Enterprise in Transportation Sector of China 129
Evaluation of Emergency Rescue Capability of Expressway Based on Improved Fuzzy Comprehensive Evaluation Method 130
Research on the Influence of Speed Limit on the Characteristic Speed of Expressway 131
Study on the Principles of Speed Limitation Scheme for New Expressway 132
Game Analysis of Economic Benefits of Railway High and Medium Speed Trains 133
Impact of Platoon Dispersion on Signal Coordination at Downgrade Arterial Segments 134
Research on Performance-Oriented Cost Regulation: Promoting the Integration of Budget Performance Management in Public Transport Industry 135
Overview of Urban Expressway Entrance Ramp Control Algorithms 137
Design Conception of Highway Based on 5.8G Free Flow 138

Bicycle Lane Capacity Model in Construction Area Based on VISSIM Simulation.....139
Sensitivity Analysis and Selection of Check Index of Signal Intersection Simulation Model Based on VISSIM.....140
Construction of Parallel Experimental Platform for Traffic on Urban Expressway Based on Multi-Source Data.....141
Cellular Automata Model for Mixed Bicycle Traffic Flow Considering Traffic Flow Compressibility.....142
Calibration of Microscopic Traffic Simulation Models Using Metaheuristic Algorithms.....143
Study on Optimal Length of Upstream Transition Zone in Construction Area of Ten-Lane Expressway.....144
Short-Term Traffic State Prediction Based on Support Vector Machine.....145
Research on Coordination and Optimal Control of Arterial Line Based on Vehicle Blocked Delay.....146
A Cumulative-Prospect-Theory-Based Bi-Modal Stochastic User Equilibrium Model Under Tradable Credit Scheme: Considering Endogenous Reference Points and Transaction Costs.....147
Research on Network Structure Characteristics and Invulnerability of China Passenger Routes.....148
Analysing the Resilience of Road Network in Urban Areas Based on the Network Topology and Traffic Characteristics.....149
Site Selection of Integrated Urban-Rural Passenger Transport Hubs by Using Combined Approach of Plant Growth Simulation and Genetic Algorithm.....150
Reliability Analysis of Travel Time of General Bus in Microscopic Interval - A Case Study of Bus Route 355 in Suzhou City.....152
Robust Bandwidth Optimization for Bus Systems Under Dwell Time Uncertainty.....153
Sensitivity Analysis of Passenger Flow on Xi'an Subway Line 3.....154
Research on Management Strategy of Shared Bicycle in Hangzhou City Based on Stakeholder Theory.....155
Calculation of the Number of People on Board Based on the Swipe IC Card Interval.....156
Evolutionary Mechanism of Competition and Cooperation Between Bus Lines Based on Passenger Volume.....157
A Continuous Model of Bus Bunching That Considering the Queue Time at Bus Station.....158
Dynamic Evolution Law and Prediction of Bus Bunching.....159
An Electric Bus Vehicle Scheduling Approach Considering the Charging Strategies.....160
Research on Real-Time Speed Control Method for Bus Bunching.....161
En-Route Bus Reliability Evaluation with Real-Time Data at Network Scale.....162
Analysis of the Influence of Bus Passengers' Ability to Enter the Car in the Form of Multi-Payment.....163
Managing Transportating Infrastructure in Nigerian Cities.....164
Study on Metro Transfer Station Time Scheduling.....165
Accurate Vehicle Detection for Autonomous Vehicle: Fusion of 3D-LIDAR and Camera Data.....166
A Interactive Simulation of Autonomous Vehicles Based on Midified Social Forces in Mixed Traffic.....167

Joint Simulation of Lane Keeping System 168
Coordinated Control Model of Autopilot Vehicle in Highway Construction Area 169
Driving Safety Assist System for Ride-Hailing Cars 170
A Summary of Research Achievements on Vehicle Lane Change in Auto-Driving Environment 171
Design and Application of Rural Roads Lifecycle Management Information System 172
Research on Intelligent Parking System Algorithm Based on Camera Calibration Model 173
Standardized Parking Management System of Shared Bicycle Based on Bluetooth Technology 174
Train Delay Recovery Time Prediction Model Based on Train Operation Records 176
Traffic Meteorology and Intelligent Highway Construction 177
Application of ETC Free Flow Toll Technology in Expressway 178
Improved Method of Lane Recognition Based on Background Filtering of Road Edge Image 179
Application of Alinea Ramp Control Algorithm for Type C Weaving Sections 180
Traffic Line Identification Based on Neural Network 181
Robust Road Detection Based on Monocular Depth Estimation Model and Improved U-V View 182
Whether the Installation Angle of Raised Pavement Markers on a Horizontal Curve Section Has an Effect on the Line of Sight Induction Performance 183
Research on the Risk Assessment and Early Warning of Road Linear Combination Complex Section 184
An Analysis on Dangerous Vehicles Parking in Expressway Service Area 185
Simulation and Analysis of Non-Symmetrical Road on Brake Performance 186
Study on the Influencing Factors about Injury Severity of Multi-Vehicle Accidents in Mountainous Areas 187
Some Synthetic Approaches of Decreasing Motorcycles Traffic Incidents on Urban Roads 188
Design of Rapid Rescue System for Major Traffic Accidents Based on Internet + Acoustic Measurement 189
Analysis of the Factors Affecting the Severity of Multi-Vehicle Traffic Accidents on Expressways 190
Prediction of Lane-Changing Behavior Based on Driver's Maneuvering Characteristics and Relative Motion Parameters 191
Safety Evaluation Method of Small Spacing Interchange Under High-Density and Heavy Traffic Flow and Improvement Measures 192
Analysis of Stability and Safety for Heterogeneous Traffic Flow in Connected Automated Vehicles Environment 193
The Impact of Transportation Infrastructure and Whole Region's Urbanization on Economic Development 194
Analysis of Bus Drivers' Crashes, Violation and Risk Driving Behaviors 195
The Safe System Approach: Accommodating Human Error 196
Research on the Urban Road Traffic Safety Evaluation Method Based on Extension Cloud Model 197
Safety Evaluation of Mountain Highway Tunnel-Inter-Channel Section 198

Traffic Safety Assessment Method of Freeway Workzone with Unidirectional Outside Lane Closed Based on the Traffic Confflicts....199
Failure Accident Mechanism of a Bridge Expansion Joint on an Expressway....200
Construction of Accident Rate Model for High-Crossing Sections of Highway Bridge in Mountainous Areas....201
Research on the Visual Illusion Speed Deceleration Marking of Road Curve....202
Research on Traffic Congestion of Urban Main Road Under Accident Conditions....203
Research on Speed Limit Model Optimization of Expressway in High Altitude Area....204
Study on Pedestrian Accident Severity Prediction Based on Random Forest....205
The Severity Analysis of Expressway Rear-End Collision Accident in Mountainous Area Based on Multinomial Logit Model....206
Analysis of the Identification of Accident-Prone Section Based on Improved Cumulative Frequency Method....207
Examining Drivers Injury Severity of Two-Vehicle Crashes Between Passenger Cars and Light Motor Trucks....208
Analysis of Factors Affecting the Severity of Traffic Accidents....209
Research on Non-Motorized Traffic Characteristics of Hybrid Retrograde Non-Motor Vehicles Based on Cellular Automaton....210
Traffic Risk Assessment of Traffic Accident Sections Based on Entropy Weight Cloud Model....211
Traffic Simulation and Safety Evaluation on Central Separation Opening of Reconstructed Freeway....212
Explore Crash Contributing Factors and Their Relationships Based on an Improved Multiple Correspondence Analysis....213
Research on a Control Method for Curve Illusion in Curve Road Section of Expressway Tunnels....215
Investigating Influence Factors of Traffic Violations Based on Surveillance Video Data....217
Research on Evaluation of the National Transportation Safety and Counter Measures Based on Comprehensive Index Model....218
Improvement Research on Slope Illusion of Urban Subaqueous Tunnel....219
The Fatal Traffic Accident in Tunnel Portal: A Case Study and Perspective....220
Eye Movement Characteristics of Drivers in Plateau....221
Considering Lane Change Heterogeneity and Collision on the Mesoscopic Traffic Flow Simulation....222
Research on Dynamic Visual Characteristics of Drivers in Prairie Road Environment....224
Research on Drivers' Perception Characteristics of Urban Road Horizontal Interference Hazard....225
Analysis of Chinese Driver's Lane Change Behavior....226
Research on Drivers' Saccade Characteristics of Urban Underwater Tunnel with Different Curvatures and Turnings....227
Placement Distance of Exit Advance Guide Sign on an Eight-Lane Expressway Considering Lane Changing Behavior....228
Research on the Classification for Road Traffic Visibility Based on the Characteristics of Driving Behaviour-A Driving Simulator Experiment....229

A Study on Driver's Behavior of Playing Mobile Phone While Waiting for Red Light Based on Kaplan-Merir Method 230
Freeway Accident-Prone Section Identification Approach Based on Driving Workload 231
Research on Driver's Visual Load of Low-Grade Highway Optical Long Tunnel 232
Experience Teaches: Examining Difference Between External and Internal Distractions in Car Following Among Inactive and Active Drivers 233
Analysis of the Impact of Taxi Driver Driving Behavior on Accidents Based on CART Decision Tree 234
Exploring Factors Influencing Risky Cycling Behaviors of Young Cyclists: A Questionnaire-Based Investigation in China 235
Research on Lane-Changing Duration and Trajectory with Consideration of Vehicle Lateral Stability 236
Investigation and Analysis Intervention of Road Rage in China 237
Cognitive Bias Analysis of Observation Ability of Novice Drivers Based on Questionnaire Data 238
Effects of Connected Vehicles of Fog Warning System on Driver Performance Based on Driving Simulator 239
The Impacts of Dialing Cell Phone on Driving Behavior 240
Analysis of Car-Following Types Based on Power Spectrum 241
Game Analysis of Pedestrian-Vehicle Interactive State on Efficiency at Signalized Intersection 242
Analysis of Fatigue Driving Behavior Based on NS Model 243
A Review of Driver Fatigue Behavior 244
An Application and Extension of the Theory of Planned Behavior to Analyze Takeaway Deliverers' Red-Light Running Behavior in China 245
Mesoscopic Traffic Flow Simulation Based on Driving Behavior Heterogeneity and Collision 246
The Motorcycle Child Helmet Initiative Project (MCHI) Protocol of SAFEKIDS Malaysia Universiti Putra Malaysia 248
Desired Safety Margin Model-Based Exploration of Driver Style Effect on Heterogeneous Traffic Flow 249
Conflict Analysis of Non-Motorized Vehicles on Isolated Bicycle Lane 250
Research on Optimization of Viewport of Approaching Section of Highway Tunnel Entrance 251
Analyzing Characteristics of Drunk Driving Behaviors Based on Data Mining of Criminal Judicial Documents 252
Study on Transverse Operation Characteristics of Automobile on Ramp of Spiral Interchange 253
Research on Vehicle Trajectory of Spiral Interchange Ramp Based on Natural Driving 255
Optimization of Customized Bus Routes Based on K-Means and Genetic Algorithm 257
Safety Analysis and Structure Optimization of Corrugated Guardrail of Expressway 259
Estimating Speed of Dynamic Traffic Shockwaves for Bottleneck Detection in a Connected Vehicle Environment 260
Delay Analysis on Road Section Under the Pedestrian Crossing Priority and Traditional

Pedestrian Crossing 261
Improved Genetic Algorithm for Multi-Vehicle CARP Problem 262
Study on Aerodynamic Effects of Cutting-Viaduct Connection Area in High-Speed Railway Using Wind Tunnel Tests 263
Study on Eco-Transportation Operation Guarantee Measures in High Altitude Area Considering Animal Traveling 264
Enhancing Real-Time Crash Risk Prediction Performance Considering Spatial and Temporal Correlations in Machine Learning Models 266
Horizontal Alignment Security Design Theory of Superhighway 267
Traffic Flow Prediction Based on Genetic Neural Network and Exponential Smoothing 268
Analysis of Influence of Traffic Monitoring on Drivers' Psychology in the Phrase of Signal Conversion 269
Analysis of the Characteristics of Conventional Public Transportation Operation in Ningbo Based on Big Data 270
A Study of Occlusion Failure of Cantilever Traffic Sign at Intersections of Urban Arterial Roads 272
Visual Characteristics of Bus Drivers at Road Signalized Intersections Based on Simulation 273
Research Progress and Prospect of Personalized Driving Behavior Study Based on Driving Fingerprint 274
Effect of Speed Difference on Electric Bicycle Riders' Eye Behaivor with Mixed Traffic 275
Research on Maintenance Cycle Technology of Urban Hybrid Electric Bus 276
Study on the Performance Test Method and Application of Pure Electric Bus from User's Perspective 277
Shanghai New Energy Passenger Vehicle Tracking Study and Fine Management Policy Recommendations 278
Feasibility Analysis and Implementation Path of Banning Sales of Fuel Vehicles in a Specific Region Based on SWOT-Taking a City(a Provincial Capital City in the Western Part of China) as an Example 279
Research on Promoting the Integration and Development of "Traffic Network" and "New Energy Network" 280
Configurations of Electric Vehicle Charging Facilities in Urban Areas 281
Research on Refined Low Impact Road Design with Multi-Professional Collaboration 282
Exploring Thermal Impact of Roads on Permafrost Using Normalized Spectral Entropy 283
Analysis and Research on Prevention and Control Measures of Dust Pollution on Expressway 285
An Experiment Study on Eco-Driving Style Acceleration During Queue Discharge at Urban Signalised Intersections 286
Commuter Exposure to Particulate Matter in Urban Public Transportation of Xi'an, China 287
Research on Bicycle Behavior Characteristics Based on Simultaneous Equations 288
Research on Speed Limit of Block System in Consideration of Environmental Cost 290
Construction Mechanism of Shanghai Vehicle Emission Real-Time Dynamic Model 291
Analysis of Pollutant Distribution Based on Taxi Travel Volume: A Case Comparison of Xi'an and Ningbo, China 292

Research on Roads with Low Noise Pavement 293
Carbon Emissions in Different Traffic Flow Patterns of Expressways 294
Discussion of Lightning Protection Technologies in Zhuhai-Hong Kong-Macao Bridge 295
Key Points and Innovation Achievements of Tourism Road Landscape Design-A Case Study of Chaohu Tourism Avenue 296
Air Field Flow and Particle Diffusion in Street Canyon Under the Influence of Viaduct and Solar Radiation 297
Grey Correlation and Prediction Analysis of Transportation Carbon Emission in Shanxi Province 298
An Improved Algorithm for the Track Circuit Adjustment Table of High-Speed Railway for Safety and Energy Saving 299
Implementation Environment and Influence of Urban Rail Construction Project 301
Under-Concerned Transfer on Rainy Days-Take Shenzhen as an Example 302
Pedestrian Exposure to Traffic-Related PM2.5, BC and UFP of Adults and Teens a Case Study in Xi'an, China 303
Evaluation and Obstacle Factor Diagnoses of Transport Low Carbon Development Based on DPSIR Framework-A Case Study of Beijing 304
Factors Affecting Wear of Rubber Particles from Tyres.....306

基于无人机视频的道路交叉口车流量调查方法

胡继华，程智锋
（中山大学）

摘　要：道路交叉口车流量调查是交通调查的重要部分，需要跟踪的车辆多，车辆的转向关系也很复杂，传统的视频车辆检测和跟踪算法难以满足要求。本文针对道路交叉口车流量调查的普适性、高精度等实际要求，以及交叉口附近车辆的运动特征，提出了一种基于无人机视频的道路交叉口车流量调查方法。该方法以道路交叉口行车区域为检测区域，将车辆检测和跟踪分成独立的两个阶段，使用背景差法检测车辆，然后使用置信度指标进行车辆跟踪。方法包括视频稳像、背景提取和交叉口行车区域定位、车辆检测、车辆跟踪等步骤。该方法使用广州大学城两个道路交叉口的视频进行了验证，车辆检测和跟踪结果的精度都达到94.49%以上，车流量调查的精度在90%以上，能够满足道路交通调查的要求。

关键词：车辆跟踪

A Traffic Survey Method for Road Intersection Based on UAV Video

Hu Jihua, Cheng Zhifeng
（Sun Yat-sen University）

Abstract:

Traffic survey at road intersections is an important part of traffic investigation. There are many vehicles to be tracking and the steering relationship of vehicles is very complicated. The traditional video vehicle detection and tracking algorithms cannot meet the requirements. In this paper, aiming at the practical requirements of universality and high accuracy of traffic survey and the characteristics of vehicle movement in the intersection, a traffic survey method for road intersection based on UAV video is proposed. With the running area of road intersection traffic area as the detection area, this method divides vehicle detection and tracking into two independent stages, the background difference method is applied to detect the vehicle, and the confidence index is applied to track the vehicle. The method includes video stabilization, background extraction, intersection location, vehicle detection, and vehicle tracking. The method is verified with the videos of two road intersections in Guangzhou University City. The accuracy of vehicle detection and tracking results is over 94.49%, and the accuracy of traffic flow survey is above 90%, which can meet the requirements of road traffic investigation.

keywords: Vehicle tracking

作者简介：胡继华，中山大学，hujihua@mail.sysu.edu.cn。

改进步行指数模型在城市步行性评价中的应用

王昊
（江苏省城市规划设计研究院）

摘　要：步行指数（walkability index）是一种量化测度步行性的方法，国内外的诸多研究都表明步行环境对步行出行方式、步行路径选择有显著影响，而既有步行指数模型未能考虑步行者对街道环境的整体感知。本文在既有步行指数模型基础上，进一步考虑步行环境的影响，通过 SP 调查确定步行环境表征因素，将步行路权形式及步行道宽度、沿线机动车开口密度、沿街界面积极程度及过街道路红线宽度 5 个影响步行环境的关键因素纳入步行指数影响因素对其进行修正，改进后的模型考虑了步行环境和安全性的影响，可更准确的测度步行性，判别步行友好程度及改进方向。以张家港市核心区对模型改进前后的结果进行了验证。

关键词：步行指数；步行环境评价；步行路权形式；慢行交通

Application of Improved Walking Index Model in Urban Walking Evaluation

Wang Hao
（Jiangsu Institute of Urban Planning and Design）

Abstract:

Walkability index is an quantitative index to measure the walkability, lots of researches have shown that the pedestrian environment has a significant impact on pedestrian trip options, however, the existing walkability index model fails to consider the overall perception of pedestrian on the street environment. Based on the revision of pedestrian index, this paper further considers the influence of actual pedestrian environment. In this study, the walkway environment characterization factors were determined by SP survey. The key factors influencing the walking environment, such as the width of pedestrian walkway, the density of motor vehicle entrances along the street, the degree of street interface and the width of streets, were included into the influencing factors of pedestrian index.Tthe index can be used to determine the degree of pedestrian friendship and the direction of the improvement. The improved walkability index model considers the influence of walking environment and safety, and can measure the walking characteristics more accurately. The results of the model before and after the improvement are verified in the core area of Zhangjiagang.

keywords: Walkability index; Walk environment evaluation; Walk right on the road; Non-motorlzed Traffic

作者简介：王昊，江苏省城市规划设计研究院，582172078@qq.com。

GPS-Based Travel Survey Method and Performance Evaluation Considering Key Influence Factors in Practical Application

Yao Zhenxing, Peter J. Jin, Yang Fei
Chang'an University Rutgers University Southwest Jiaotong University

Abstract: GPS-based travel survey method is an emerging technology proved to be effective for trip chain information collection. Various trip information detection methods have been proposed by previous studies, however studies on the development of a reliable trip information detection method are still limited. Meanwhile, the influence of several key technical factors in application, such as travel mode, traffic condition, data sampling frequency and data processing algorithms etc. have not been analyzed and evaluated. Therefore, in this paper, a hybrid model for GPS-based travel survey is proposed based on the performance evaluation and comparison using different algorithms and data. First, four most popular machine learning algorithms (MLAs) including neural network, support vector machine, Bayesian network and random forest, cooperated with a GIS-based map matching algorithm (GMM), are used to extract trip chain information; Second, the influence of different technical factors including trip mode (10 multi-modes), data sampling frequencies (1s to 120s), traffic conditions (non-peak and peak hour traffic) and algorithms (only MLAs and MLAs+GMM) are evaluated. Results show that all the proposed algorithms can be applied for GPS-based trip mode detection. Results are similar and relatively low when using only MLAs. The GMM algorithm contributes a lot to improve the bus and car mode detection. Data sampling frequency and traffic condition obviously influence the model performance. A high data sampling frequency and free traffic condition helps to improve the outcomes. Trip mode detection rates reach 80% and mode transfer time detection errors are within 1 minute when data sampling frequency is smaller than 5s both under free and congestion condition.

keywords: GPS-based Travel Survey, Machine Learning, GIS, Trip chain information, performance evaluation

基于 PSPL 调查方法的老城区生活性街道改造——以安康市汉滨区静宁南路为例

薛冬[1]，陈建新[1]，孙宏亮[1]，韩传玉[2]
（1. 长安大学；2. 中国铁路设计集团有限公司）

摘　要：随着中国快速发展，老城区的改造也越来越多，本文调查了安康市老城区生活性街道现状并引入 PSPL 调研方法对安康市老城区生活性街道进行调研。根据调查的问题，提出安康老城区生活性街道改造策略，为老城区生活性街道改造工作提供参考。

关键词：PSPL 调查方法；老城区；生活性街道；街道改造

Reconstruction of Living Streets in the Old City Based on PSPL Survey Method-Taking Jingning South Road in Hanbin District of Ankang City as an Example

Xue Dong[1], *Chen Jianxin*[1], *Sun Hongliang*[1], *Han Chuanyu*[2]
（1.Chang'an University; 2.China Railway Design Corporation）

Abstract:

With the rapid development of China, the reconstruction of the old city is more and more. This paper investigates the current situation of living streets in the old city of Ankang City and introduces the PSPL research method to investigate the living streets of the old city of Ankang. According to the investigation questions, the strategy of living street reconstruction in the old city of Ankang is proposed to provide reference for the reconstruction of living streets in the old city.

keywords: investigation method of PSPL; old city; living street; street reconstruction

作者简介：薛冬，长安大学，2825795917@qq.com。

江苏省过江交通出行 OD 调查与交通特征研究

徐逸昊，白桦
（中设设计集团股份有限公司）

摘　要：基于 2018 年 4 月进行的江苏省过江交通设施交通量 OD 调查及数据分析，尝试通过多源数据收集和分析手段，挖掘江苏省过江交通现状特征及发展趋势。调查通过对高速公路收费数据、汽渡票根数据、微信电子问卷数据和手机信令数据等多源数据的融合利用和挖掘分析，对 23 条过江通道的交通量从客运和货运两个维度进行来源地-目的地分析及出行特征分析。总体而言，江苏省过江交通量客货运占比总量较为平均但呈现一定的地区差异。过江交通量呈现以南京和上海为核心的放射状分布，并在各区段城市内形成一定的一体化交通规模。跨市过江出行仍以公务、旅游为主，通勤交通量较少，车辆过江出行频次较低。货运交通量分布和城市的产业结构密切关联。

关键词：交通管理；交通调查；多源数据融合；OD 矩阵

Research on OD Estimation and Transportation Features of Cross-River Pathways in Jiangsu Province

Xu Yihao , Bai Hua
（CHINA DESIGN GROUP CO.,LTD.）

Abstract:

This article tries to display the current feature of cross-river transportation of Jiangsu Province and its possible developing trend by collecting and processing multi-source data, based on the cross-river traffic survey and following analysis in April, 2018. By the process of information mining, integration and analysis on highway charging information, steam ferry charging information, online survey and mobile signaling data, the research analyzes both the cross-river passenger traffic and freight traffic. In general, the passenger/freight proportion of the cross-river traffic in Jiangsu is even in volume but distinguished in region. The traffic volume distributes radially from Nanjing and Shanghai, and displays urban traffic characters within small region. However, most of the cross-river traffic between cities has the purpose of business/travelling, commuter volume is rare and overall frequency of cross-river trip is low. The freight type distribution of the traffic connects closely to the local industrial structure.

keywords: transportation management; traffic survey; multisource data fusion; OD matrix

作者简介：徐逸昊，中设设计集团股份有限公司，804645130@qq.com。

城市大型建设项目交通影响分析的回顾与展望

吴奂东，白竹
（沈阳建筑大学）

摘　要：随着我国城市化水平的不断提高，城市对土地的开发和利用不断增加，由城市大型建设项目导致的局部交通流量不平衡，会加剧城市的交通拥堵和环境污染等问题。交通影响分析是从微观上改善交通和城市空间利用的有力工具，是定量分析城市建设开发项目或土地利用变更对交通的影响，并提供相应的交通方案改进措施，以减少建设方案对其周边交通的影响。本文总结了现今国内外对建设项目交通影响分析的研究理论、研究方法和技术方案，并通过一些具体案例归纳出利用交通影响分析解决实际交通问题的具体措施。通过研究总结可以看出，利用交通影响分析可将大型建设项目对城市局部交通的影响尽可能降至最低。

关键词：交通影响分析

Review and Prospect of the Impact of Large Urban Construction Projects on Traffic

Wu Huandong, Bai Zhu
（Shenyang　jianzhu　University）

Abstract:

With the continuous improvement of China's urbanization level, urban land development and utilization are increasing, and the imbalance between traffic supply and demand caused by large urban construction projects will lead to serious problems such as aggravated traffic congestion, increased traffic accidents and worsening environmental pollution. Traffic impact analysis is a powerful tool to improve traffic and urban space utilization from a micro perspective. It is a quantitative analysis of the impact of urban construction and development projects or land use changes on traffic, and provides corresponding improvement measures of traffic schemes to reduce the impact of construction schemes on surrounding traffic. This paper summarizes the current domestic and foreign research theories, research methods and technical solutions for traffic impact analysis of construction projects, and through some specific cases summarizes the use of traffic impact analysis to solve the actual traffic problems of concrete measures. It can be seen from the research summary that the impact of large-scale construction projects on local urban traffic can be minimized by traffic impact analysis..

keywords: traffic impact analysis

作者简介：吴奂东，沈阳建筑大学，wuhuandong23@163.com。

Analysis for Joint Impact of Various Operation Factors on Streetcars' Travel Time

Li Hongming
Tongji University

Ou Dongxiu
Tongji University

Abstract: The research focuses on how to quantify the joint impact of the various factors which influence the travel time of the streetcars a lot. During the process of modelling, it is evident that the variables can be categorized into two different aspects, that is, the physical parameters and the "volatile" one. The former one relates to the factors like distance, the intersection num, while the latter refers to something like the signal strategy, traffic volume, etc. To overcome the problem of measuring the impacts of volatile factors, it is of great significance to extract the "stopping time" which refers to the sum time when the tram is delayed at the intersections. Having that information extracted using AVL data, the multiple linear regression method is utilized to get all those variables modeled quantitatively. The consequences show that both the stopping time and the intersection num own positive influence to the travel time of trams, while the station location is contrary to that of impact. Besides, it also can be obtained that the travel time would be higher when the platform is the "island type", under the circumstance of remaining other conditions the same. Furthermore, the distance has a slight negative influence on the travel time, for it reveals the phenomenon that the essential start and stop time while trams are running on the track and when the segment is short, the start and stop time will greatly influence the travel time of the tram. Finally, the travel time of a tram line to be constructed is estimated using the proposed model, which is instructive to the construction of the tram line.

keywords: Travel Time, Streetcar, Automatic Vehicle Location Data, Multiple Linear Regression, Probability Distribution

基于有轨电车接驳的城市公共自行车租赁点规模设置研究

张鹏，吉柯
（长安大学）

摘　要：目前，城市公共自行车系统已经逐渐在各个城市流行起来，但由于缺乏科学合理地车辆配置，自行车系统的循环运行效率不高。为提高居民出行“最后一公里”的舒适度，本文首先采用多项 logit 模型对公共自行车借还需求进行预测，通过对居民的问卷调查，确定换乘接驳用户选择出行方式的影响因素；其次运用 SPSS21.0 对模型进行标定；最后对淮安市有轨电车 1 号线沿线的典型站点的桩式公共自行车进行规模配置，确定各站点公共自行车租赁点的自行车数量和停车桩数量设置。

关键词：有轨电车；公共自行车；多项 logit 模型；租赁点规模

Research on the Scale of Public Bicycle Rental Point Based on Tram Car

Zhang Peng , Ji Ke
（Chang'an University）

Abstract:

At present, urban public bicycle systems have gradually become popular in various cities, but due to the lack of scientific and rational vehicle configuration, the cycling system is not efficient. In order to improve the comfort of the “last mile” of residents' travel, the Multinomial Logit Model (MNL) was used to predict the demand for public bicycles in this paper. Through the questionnaire survey of residents, the influencing factors of the travel mode of the transfer users were determined. Secondly, the MNL was calibrated by the SPSS21.0 software. Thirdly, the public bicycle scale of the typical station along the No. 1 line of Huai'an Tram Line was configured. Finally, the number of bicycles and parking piles at the public bicycle rental points of each station was determined..

keywords: tramcar; public bicycle; multinomial logit model; bicycle rental point scale

作者简介：张鹏，长安大学，2017221136@chd. edu. cn。

成绵乐经济走廊高速公路差异化收费方案影响分析

喻翔，梁艳洁，魏强
（四川省交通运输厅公路规划勘察设计研究院）

摘　要：根据交通运输行业推进供给侧结构性改革，促进物流业“降本增效”，降低实体经济企业成本的决策部署，结合四川高速公路网运行的实际情况，从对高速公路运营收入影响的定量测算和对区域经济社会发展作用的定性分析两个方面，分析了成绵乐经济走廊高速公路对货车试行差异化收费方案的影响，并提出相关建议措施，为全省高速公路收费动态优化调整长效机制的建立提供决策参考。

关键词：差异化收费

Analysis of Differential Expressway Toll Scheme of Mianyang- Chengdu -Leshan Economic Corridor

Yu Xiang, Liang Yanjie, Wei Qiang
（Sichuan provincial transport department highway planning, survey, design and research institute）

Abstract:
According to the decision deployment to promote the supply side structural reform on transportation industry, promote the logistics industry "reduce costs and efficiency", reduce the cost of the real economy enterprise, the impacts on differential expressway toll scheme for freight vehicles of Mianyang- Chengdu -Leshan economic corridor were studied. Combined with the operation of Sichuan expressway network, the impacts on toll income were calculated, and the roles of regional economic and social development were analyzed. Some relevant suggestions were put forward in order to provide reference for the establishment of the long term mechanism of dynamic adjustment of expressway toll in Sichuan Province.
keywords: Differential toll

作者简介：喻翔，四川省交通运输厅公路规划勘察设计研究院，362894377@qq. com。

基于时间序列分析的柴油客车月度能耗预测

李萌，纪少波，廖宝梁，吕承举，廉静，王豪，赵同军
（山东大学 山东大学 山东省交通科学研究院 山东省交通科学研究院 山东大学 山东大学）

摘　要：车辆的能耗既与经济有关又与环境有关，为掌握车辆的未来能耗，本文建立了适用于柴油车辆月度能耗的预测模型。首先对山东省某客运企业柴油客车月度能耗数据进行趋势性及平稳性分析，结果表明柴油车辆能耗具有逐月下降的趋势且二阶差分后平稳。然后通过自相关及偏自相关检验，证明了此能耗数据适用于ARIMA模型，并最终确定预测模型为ARIMA（2，2，2）。最后经误差检验，得到模型精度达93%以上，能够满足实际应用要求。

关键词：公路交通；能耗预测；时间序列分析；柴油客车；ARIMA模型

Monthly Energy Consumption Forecast of Diesel Bus Based on Time Series Analysis

Li Meng, Ji Shaobo, Liao Baoliang, Lv Chengju, Lian Jing, Wang Hao, Zhao Tongjun
（Shandong University　Shandong University　Shandong Transportation Institute　Shandong Transportation Institute Shandong University　Shandong University）

Abstract:
The energy consumption of vehicles is related to both economy and environment. In order to grasp the future energy consumption of vehicles, this paper established a prediction model applicable to the monthly energy consumption of diesel vehicles.Firstly, the trend and stationarity of the monthly energy consumption data of diesel buses in a passenger transport enterprise in Shandong province were analyzed.Then through the autocorrelation and partial autocorrelation tests, it was proved that the energy consumption data was applicable to the ARIMA model, and the prediction model was finally determined to be ARIMA (2,2,2).In the end, by error test, the accuracy of the model is more than 93%, which can meet the requirements of practical application.
keywords: highway traffic; energy consumption prediction; time series analysis; diesel bus; ARIMA model

作者简介：李萌，山东大学，1575499346@qq. com。

An Effective Strategy to Improve the Accuracy of Individual Travel Mode Detection Based on GPS Data

Yang Zhou（China）
同济大学
txzhpy@sina.com

Yan Jieji (China)
东南大学交通学院
jiyanjie@seu.edu.cn

Chao Yang (China)
同济大学
tongjiyc@tongji.edu.cn

Liang Penggao (China)
东南大学
seugaolp@163.com

Abstract： Collecting individual Global Positioning System (GPS) trace using smartphones has become an innovate means of travel survey, but it is insufficient to immediately replace the traditional manual surveys due to the limited accuracy of travel patterns detection. For detecting travel mode with GPS trace, previous studies paid attention to the various machine learning models application instead of features selection or distinction between ambiguous transports. To further improve the accuracy of detection, this paper firstly test the factors of ambiguity when taking e-bike into consideration, and then explores the crucial features that contributes to the detection. Results show that the confusions between bicycle and e-bike as well as between bus and car are more difficult to be distinguished. After selecting features of duration, distance, stop times, and stop frequency, the comprehensive accuracy has a significant increase and ultimately reaches to 89.2%. The appropriate machine learning algorithms and features are vital to the accuracy improvement of travel mode detection, which will in turn promote the development of travel survey techniques.

Key words： Travel survey; Travel mode; Feature selection; Random forest; GPS data

Microscopic Analysis of Behavior Perspective in the Congestion Formation Near Freeway Bottleneck with Three-Phase Theory: Spatiotemporal Study the Vehicle Trajectory Data from Aerial Video in China

Guo Qingpeng
Yu Zheng
Guilin University of Electroic Technology

Abstract: In this paper, the advanced vehicle tracking and extraction technology was used to obtain the trajectory data of the traffic flow state change (from free flow to congested flow) of Shuangqiaomen viaduct expressway in Nanjing, China. The features of formation process and propagation in frequent traffic congestion near the expressway bottleneck area were studied. We explored the characteristics of Chinese driving behavior in spatio-temporal changes from a microscopic lever. This paper contains two main contents: (i) based on the three-phase traffic flow theory, the spatial and temporal distribution characteristics of speed and the characteristics of each phase were studied, and the causes of congestion formation and the driving behavior characteristics during the transition process were explored from the perspective of phase transition; (ii) based on the vehicle trajectory to explore the location, formation cause and propagation characteristics of the oscillations from microscopic lever, it was found that the lane change behavior is the main reason for causing and aggravating the influence degree of the oscillations and phase transition in three-phase. The driving behavior characteristics generated by the lane changing and the influence on the stability of traffic flow were analyzed. The research results are advanced and special, and systematically demonstrate and study the characteristics of typical bottleneck congestion on expressway.

keywords: Three-phase traffic theory; Phase transitions; Traffic oscillations; Lane changing; Driver behavior

Highway Evasion Detection and Analysis Based on Improved Fast Peak Clustering Algorithm

Li Wei（China）
长安大学
wei.li_chd@foxmail.com

Zhang Yingjie（China）
长安大学
2632061401@qq.com

Deng Ranran（China）
长安大学
815527752@qq.com

Ding Minghang（China）
长安大学
447396777@qq.com

Sun Zhaoyun（China）
长安大学
zhaoyunsun@126.com

Hu Yanju（Canada）
加拿大滑铁卢大学
ju_huyan@outlook.com

Abstract： With the construction and development of expressways, mining the information of escaped vehicles has become the primary problem that needs to be solved in the control of highway operations. In order to better identify and analyze highway evasion incidents, a data mining method for highway evasion and analysis is proposed in this paper using highway mass toll data. First, the data of October 2016 is selected from the vast amount of highway ETC charging data of Guizhou Province, and all the data with the inbound number 432 and the outbound number 433 are selected, and only some of the fields related to this article are retained. Then the KNN-based improved adaptive fast peak algorithm proposed by the paper is used to cluster the selected data and the clustering result is output. Afterwards, the other three clustering algorithms are used to conduct comparative experiments for the same data, which verifies the robustness of the proposed algorithm in discriminating the escape behavior. Finally, the abnormal data obtained by clustering is analyzed, and the traffic mode of the escaping vehicle is excavated. The experimental results show that the proposed algorithm can effectively identify the highway evasion behavior, which can better solve the problem the problem of difficult to manage highway tolls, offer more reliable traffic perception information for the highway operation and control, and provide theoretical support for the practical application and operation strategy of the highway control measures.

Key words： highway evasion detection; data mining; KNN; improved fast peak clustering; Toll station data

Detection of Traffic Congestion from Ultra-Low Frame Rate Images Applied in Large Regional Surveillance System via Deep Residual TrafficNet

Wang Ping (China)
长安大学
wang0372@e.ntu.edu.sg

Hao Wenbang (China)
长安大学
wenbangh@chd.edu.cn

Jin Yinli (China)
长安大学
yljin@chd.edu.cn

Wang Jun (China)
陕西省高速公路收费中心
368958510@qq.com

Abstract： With current freeway surveillance system, it is hard to report traffic congestion promptly when it happens randomly, although the freeway surveillance system has been collected large number of videos and images in the daily monitoring. The accuracy of traditional visual detection is not high enough to meet the requirements of practical applications in consider complicated road situations including block, various illumination, weather condition, wearied equipment and other disturbances. In this paper, in order to promote the application of the deep learning approaches into transportation application, a network structure is proposed based on residual learning to detect traffic congestion. The accuracy of our proposed TrafficNet to classify congested and non-congested road states reaches 95% in the testing process. This proposed TrafficNet is verified by a regional detection of traffic congestion on a large-scale surveillance system currently using in Shaanxi Province and get high accuracy in this case study. Early and prompt detection can prevent extended congestion with devastating evolution from the initial controllable traffic congestion, which is one of important applications in intelligent transport system (ITS).

Key words： Congestion; Deep learning; Freeway; Residual network; Traffic surveillance system

Research on Lane-Level Vehicle Lane Change Strategy Based on NGSIM Data

Lin Xiangran (China)
西南交通大学
l_xiangran@163.com

Liu Xiaobo (China)
No.999, Xi'an Road, Pidu district, Chengdu, China
xiaobo.liu@swjtu.cn

Cao Peng (China)
No.999, Xi'an Road, Pidu district, Chengdu, China
caopeng@swjtu.edu.cn

Abstract： With the gradual maturity of automatic vehicle technology, traditional route planning can no longer meet the requirements. It is urgent to use high-precision map positioning technology to complete lane-level path planning. The existing lane-level path planning is carried out from the aspects of lane change risk, unsafe factors, and actual implementation. The rationality of the lane change strategy is not studied. Based on the NGSIM data, this paper studies the relationship between the number of lane change and the lane-level travel time, and proposes the section-level travel time as the criterion for the lane change strategy, and further analyses the vehicle time-space trajectory map to obtain the optimal lane change strategy. The results of this paper optimize the vehicle lane change strategy, greatly improve the safety of the road network, ensure the smooth and efficient driving, and have high practical value. At the same time, it provides a new idea for the research of the subsequent unmanned vehicle strategy.

Key words： route planning; lane-level travel time; space-time trajectory map; road network security; lane change strategy

车辆自燃事故聚类分析

田佳雨，郝璐，熊豪，叶邕
（长安大学）

摘　要：随着汽车保有量的不断增加，出现的汽车事故也越来越多，汽车火灾事故一旦发生，势必会造成或多或少的经济损失，还极可能造成人员伤亡，因此对汽车火灾事故进行聚类分析，区分汽车火灾事故类别，分析起火原因，对预防和避免汽车起火很有帮助。对于汽车火灾事故的聚类分析，要保证分析结果的准确可靠，需要获得真实的数据，因此从长安大学机动车物证司法鉴定中心进行数据调研，调研之前对调研内容和调研表格进行思考与设计，获得调研数据之后，先采取简单的统计方法对数据进行统计分析，分析结果说明了汽车火灾事故涉及各种车辆，起火原因复杂，且近几年自燃事故多发，对汽车火灾事故的聚类分析有一定帮助。为了进行汽车火灾事故的聚类分析，将所有起火原因进行细分，并将调研数据赋值变为数值变量，通过 SPSS 统计分析软件进行聚类分析，得到聚类的图表结果，对图表结果进行分析，结果实际情况和实际需要，将汽车火灾事故合理的分类。汽车火灾事故的相关研究较少，因此要对汽车火灾事故的聚类分析结果进行具体的分析和说明，结合调研具体事故案例，对每一种汽车火灾事故类别进行分析，对于针对性的预防此类事故发生和有效的避免此类事故具有重要意义。

关键词：汽车火灾；聚类分析

Clustering Analysis of Vehicle Spontaneous Accidents

Tian Jiayu, Hao Lu, Xiong Hao, Ye Yong
（Chang'an University）

Abstract:

With the increase in car ownership, the emergence of more and more car accidents, the number of car fires also increased, the car before the fire, not easy to detect, after the fire, the rapid spread of the fire, ferocious fire, it is difficult Save. Car fire accident in the event, it is bound to cause more or less economic losses, but also likely to cause casualties, so the car fire accident cluster analysis, distinguish between car fire accident category, analysis of fire causes, to prevent and avoid the car fire Very helpful.For the vehicle fire accident cluster analysis, to ensure accurate and reliable analysis of the results, the need to obtain real data, so from the Changan University Vehicle Certification Center for data research, research before the research content and research forms to think and design, After obtaining the research data, the statistical analysis method is used to analyze the data. The analysis results show that the automobile fire accident involves various vehicles, the cause of the fire is complicated, and the spontaneous combustion accident occurs in recent years.The cluster analysis of the automobile fire accident has Must help.In order to analyze the cause of automobile fire accident, all the causes of fire were subdivided and the value of the survey data was changed into numerical variables. Cluster analysis was carried out by SPSS statistical analysis software to obtain the clustering chart results, and the results of the chart were analyzed , The actual situation and the actual needs of the results, the car fire accident reasonable classification. Automobile fire accident related research less, so the car fire accident cluster analysis results of the

specific analysis and description, combined with the investigation of specific accident cases, for each type of car fire accident category analysis, for the prevention of targeted Class accidents and effective avoidance of such accidents are of great importance..

keywords: automobile fire; cluster analysis

作者简介：田佳雨，长安大学，125224001@qq.com。

基于差分的长短期记忆网络的高速公路交通量预测

孙朝云，凤少伟，李伟，申浩
（长安大学 长安大学 长安大学信息学院 长安大学）

摘　要：高速公路交通量预测是智能交通系统的重要组成部分，高速公路网络承担了居民出行和社会资源调配的重要作用，是管理者对路网状态进行有效管理的依据。随着人工智能和机器学习的不断发展，深度学习在交通工程领域得到了广泛的应用。本文基于时间序列的角度，首先通过深度学习的方法提取交通量数据的特征；然后结合数据差分法提出了基于差分的长短期记忆（Difference-long short term memory，D-LSTM）网络的交通流预测模型；最后选取云上贵州的高速公路收费数据，对本文所提出的模型进行了验证。结果表明，与传统 LSTM 网络相比，D-LSTM 的预测准确率提高了 4.14%，达到了 96.47%，并且预测结果稳定、可靠，因此 D-LSTM 模型的预测性能更好，可以为城市交通管理系统提供可靠的交通量预测方法。

关键词：交通量预测；时间序列；差分；神经网络

Highway Traffic Volume Prediction Based on Differential Long and Short-Term Memory Networks

Sun Zhaoyun , Feng Shaowei, Li Wei, Shen Hao
（Chang'an University　Chang'an University 长安大学信息学院　Chang'an University）

Abstract:

Highway traffic volume prediction is an important part of intelligent transportation system. The highway network bears the important role of residents' travel and social resource allocation, and it is the basis for managers to effectively manage the road network status. With the continuous development of artificial intelligence and machine learning, deep learning has been widely used in the field of traffic engineering. Based on the perspective of time series, this paper firstly extracts the characteristics of traffic volume data by deep learning method. Then, based on the data difference method, the traffic flow prediction based on differential long-short term memory (D-LSTM) network is proposed. The model is selected. Finally, the highway toll data of Guizhou is selected, and the model proposed in this paper is verified. The results show that compared with the traditional LSTM network, the prediction accuracy of D-LSTM is improved by 4.14%, reaching 96.47%, and the prediction result is stable and reliable. Therefore, the prediction performance of D-LSTM model is better, and it can be used for urban traffic management. The system provides a reliable method of predicting traffic volume.

keywords: traffic volume prediction; time series; difference; neural network

作者简介：孙朝云，长安大学，zhaoyunsun@126.com。

地铁客流量灰色关联度及预测模型研究

叶然然，赵姣
（长安大学 陕西省西安市碑林区长安大学）

摘　要：在仅有通车 5 年的地铁客流量小样本数据条件下，为了合理、科学地预测各城市地铁客流量，量化不同影响因素对客流量的影响程度，本文提出了基于 Matlab 的灰色系统地铁客流量预测模型；以实际调研的三个城市 8 条地铁线路的统计数据为样本，运用灰色关联度模型对不同影响因素的影响程度进行量化评估；分别建立 GM（1，1）单变量预测模型与 GM（1，N）多变量预测模型对客流量进行预测分析。研究结果表明：本文选取的影响因素对客流量的灰色关联度均大于 0.5，说明它们对客流量均具有较大影响；GM（1，1）预测模型 85%的预测结果误差在 10%以内，GM（1，N）预测模型 80%的预测结果误差大于 40%，从而得出 GM（1，1）预测模型比 GM（1，N）预测模型的预测结果更加准确。

关键词：交通运输工程；地铁客流量预测；灰色关联度；灰色预测模型

Research on Grey Relational Grade and Prediction Model of Subway Passenger Flow Quantity

Ye Ranran , Zhao Jiao
（Chang'an University 陕西省西安市碑林区长安大学）

Abstract:

Under the condition of small sample data of metro passenger flow quantity with only 5 years of operation, in order to predict metro passenger flow quantity reasonably and scientifically in each city, the research quantified the influence degree of different influencing factors on passenger flow quantity.This paper proposes a prediction model of the grey system of subway passenger flow quantity based on MATLAB. Based on the statistical data of 8 metro lines in three cities, this paper quantitatively evaluates the influence degree of different influencing factors by using grey correlation grade model, and establishes the GM (1,1) single variable prediction model and the GM (1,N) multi-variable prediction model to predict the passenger flow quantity. The results show that the grey correlation degree of the influencing factors selected in this paper is greater than 0.5, which indicates that they have great influence on the passenger flow quantity. The prediction error of the GM (1,1) prediction model of 85% is less than 10%, and that of the GM (1,N) prediction model of 80% is more than 40%,which indicates that the GM (1,1) prediction model is more accurate than the GM (1, N) prediction model. Therefore, the single variable prediction model is more reasonable and scientific for the small sample data prediction of subway passenger flow quantity for 5 years.

keywords: Transportation engineering; subway passenger flow quantity forecasting; grey correlation degree; grey prediction model

作者简介：叶然然，长安大学，2906376197@qq.com。

运用电子票证数据推估大众运输旅次讫点算法构建与验证

林至康，张志鸿，苏昭铭
（福建省闽江學院 台湾中华大学 台湾逢甲大学）

摘　要：目前台湾地区大众运输的刷卡系统分为一段式刷卡与两段式刷卡两种方式，但由于一段式刷卡电子票证之内容仅记录乘客上车单一信息，无法统计出路网中各路线各站起讫点间之运量资料(O-D table)，有鉴于此，本研究旨在利用电子票证一段次刷卡纪录，并结合电子票证与地区土地分区数据，建立一段式电子票证刷卡数据的三阶段旅次讫点推估算法。

关键词：电子票证；巨量数据；旅次讫点推估；大众运输

Applying Smart Card Data to Estimate and Validate the Destination of Individual Trips in Transit Systems

Lin Chihkang , Zhang Zhihong , Su Jauming
（福建省闽江學院 台湾中华大学 台湾逢甲大学）

Abstract:

The smart card fare collection system currently used in Taiwan according to one or two sections, but the one-section system only record the boarding transactions (“tap-in”) and not the alighting transactions (“tap-out”) in the system. In this paper, we make use of the one-section smart card fare tallying record, combined with the smart card records and regional zoning information, in order to establish a three-stage trip algorithm to estimate the destinations.

keywords: smart card; big data; trip destination; public transit

作者简介：林至康，福建省闽江学院，cklin1172@qq.com。

基于机器学习的公交车 GPS 数据线路分类和识别研究

施敏

（南京市城市与交通规划设计研究院股份有限公司）

摘　要：针对公交 GPS 数据中存在的线路分类与实际运营行驶线路不符的问题，本文提出了一种基于机器学习的公交 GPS 数据线路分类识别算法。首先计算出每辆公交车行驶的轨迹路径选路径集，经过筛选聚类，得到线路轨迹路径集作为分类训练集，分别采用了五种机器学习算法对测试集合进行线路分类判断，并识别每辆车的所属线路分类。试验结果表明：采用基于机器学习分类算法均可以剔除线路中非按正常线路运营的车辆，其中神经网络算法的精度达到 100%，高斯朴素贝叶斯、线性支持向量机、径向基内核支持向量机的准确率也达到了 98.8%。同时，在识别公交线路分类预测方面，神经网络算法的准确率也达到了 99.42%。

关键词：公交 GPS；机器学习；公交线路分类；支持向量机；神经网络

Research on Classification and Recognition of Bus GPS Data Line Based on Machine Learning

Min Shi

（Nanjing Institute Of City & Transport Planning Co..Itd）

Abstract:

Aiming at the problem that the line classification existing in the bus GPS data does not match the actual operating route, this paper proposes a classification and recognition algorithm based on machine learning for bus GPS data lines. Firstly, the path path selection path of each bus is calculated. After screening and clustering, the route path path set is obtained as the classification training set. Five machine learning algorithms are used to classify the test set and identify each vehicle. The classification of the vehicle to which it belongs. The test results show that the machine-based classification algorithm can eliminate vehicles that are not operated according to the normal line, and the accuracy of the neural network algorithm reaches 100%. Gaussian naive Bayes, linear support vector machine, radial basis kernel support vector The accuracy of the machine also reached 98.8%. At the same time, the accuracy of the neural network algorithm has reached 99.42% in identifying the classification of bus routes.

keywords: bus GPS; machine learning; bus route classification; support vector machine; neural network

作者简介：施敏，南京市城市与交通规划设计研究院股份有限公司，memoryyeah@126.com。

基于 IC 卡数据的公交下车站点智能推断方法

杨鑫，左兴权
（北京邮电大学）

摘　要：公交 IC 数据隐藏着丰富的乘客出行信息，但在我国多数城市中乘客下车信息未被记录，给客流分析和公交调度优化带来了很大困难。本文提出一种利用 IC 数据中乘客上车信息和公交站点 GPS 数据来推断下车站点的方法。首先，提出换乘和往返推断这两种强规则得到部分高准确率的推断结果，接着将问题看成是序列化标记问题，采用结合双向长短时记忆网络和条件随机场的模型（Bi-LSTM-CRF）来推断每条记录的下车站点。经过大量真实数据测试，本方法的准确率在不同类型乘客上均明显高于传统方法。

关键词：公交数据挖掘；下车站点推断

IC Card Data Based Intelligent Approach to Estimate the Passenger Alighting Stations

Yang Xin, Zuo Xingquan
（北京邮电大学）

Abstract:

The bus IC card records have rich passenger travel information, but the alighting information of passengers is missing in most cities of China, which brings great difficulties for passengers flow analysis and bus scheduling optimization. This paper proposes an approach to infer the alighting stations of passengers using the boarding data of IC card and bus stations' GPS data. First, two types of strong rules of transfer inference and round-trip inference are proposed to get partial results with high accuracy. Then, the problem is tranformed into a sequence tagging problem, and the Bi-LSTM-CRF model is used to predict each record’s alighting station. The test on a lot of real data shows that the accuracy of the approach is much higher than those of the traditional methods for all types of passengers.

keywords: Bus data mining; alighting station inference

作者简介：杨鑫，北京邮电大学，yxwithu@163.com。

Trip End Identification Based on Spatial-Temporal Clustering Algorithm Using Smartphone GPS Data

Yao Zhenxing , Zhou Jianyao, Peter J. Jin ,Yang Fei
Chang'an University Southwest Jiaotong University Rutgers University Southwest Jiaotong University

Abstract: As a widespread portable probe, smartphone equipped with Global Positioning System (GPS) has a good availability in tracking individual’s travel trajectory, it is potential for trip end information identification. Existing studies mostly use rule-based methods with specific dwelling time and distance thresholds for trip end detection, these methods are highly dependent on the expert experience and lack universality across different traffic environment. Some clustering-based methods also have issues when GPS signal is missing or multiple short time stops occur at the same location (causing redundant detection errors). Therefore, this paper proposes a two-step method for trip end identification by using smartphone GPS data. First, a spatial-temporal density based clustering algorithm (ST-DBCA) is proposed for trip end identification, the method considers both spatial and temporal GPS trajectory density at the same time, and performs much better than traditional methods. Second, three optimization models are further proposed for result optimization, including 1) a short time stay optimization model, 2) a redundant stay optimization model, and 3) a traffic congestion stay optimization model. Field test results show that the proposed methods have good performance in both accuracy and consistency. The average trip end identification accuracy under various trip purposes reaches 92.4%, and the average error of arrival/departure time is smaller than 150 seconds.

Key words: Travel Survey, Trip End Identification, Smartphone GPS Data, Spatial-Temporal Density Based Clustering Algorithm

基于改进小波神经网络的高速公路季节性车流量预测模型

陈通箭，向红艳
（重庆交通大学）

摘　要：高速公路月车流量具有非线性上升趋势性和季节变化性，针对这个问题，研究提高高速公路的月度车流量预测的方法。综合分析季节指数能够消除原始数据中的季节变化性的前提下，结合小波神经网络具有良好的非线性预测性等特性，引入有季节指数的小波神经网络（SWNN）预测模型。选取贵州某高速 5 年的车流量，采用平均相对误差、平均绝对误差、均方差三个评价指标，对改进前后的 WNN 预测结果进行评价。结果表明，总体上看，有季节指数的小波神经网络模型精度比单纯的小波神经网络高，有些月份的预测精度达到 1%，可移植性较好。该方法适用于高速公路月车流量的预测，为高速公路运营管理提供依据。

关键词：高速公路；交通量预测；季节指数；小波神经网络；误差评价指标

Forecasting Method of Seasonal Highway Traffic Based on Improved Wavelet Neural Network

Chen Tongjian, Xiang Hongyan
（Chongqing Jiaotong University）

Abstract:

The monthly highway traffic has the dual trend feature of nonlinear increasing trend and seasonal fluctuation. In order to solve this issue, a improved forecasting precision of monthly highway traffic is arranged. Under the premise of the comprehensive analysis about the characteristic of seasonal index that can eliminate the seasonal fluctuation in origin date, combining with the advantages of WNN that has well nonlinear predictability, the seasonal index wavelet neural network (SWNN) was adapted. 5 years highway traffics was selected, the comparison of WNN and SWNN prediction result was evaluated by using three index——MRE, MAE and MSE. The result shows that SWNN has more accuracy rating than WNN, well model transferability, some monthly error is 1% and is suitable for forecasting of highway monthly traffic. Therefore, this model can provide a reference for operational planning of highway.

keywords: highway; traffic flow forecasting; seasonal index; wavelet neural network; error evaluation index

作者简介：陈通箭，重庆交通大学，2833664698@qq. com。

The Study of the Relationship Between Traffic Density and Lane-Changing Behaviors in Urban Expressway

Xie Han,Jiang Yang Sheng,Ren Qing Hua,Ma Yuan
Xihua University Southwest Jiaotong University Xihua University Southwest Jiaotong University

Abstract: In the urban expressway of China, a large number of exits result in frequent lane-changing behaviors, which make the traffic in weaving. Traffic flow density directly reflects the traffic demand. But lane-changing behaviors affect the traffic density in reality. So the study of the relationship between lane-changing behaviors and traffic density is an important part of understanding the mechanism of urban expressway. In this paper, we used data-driven modeling method and the ideas of three-phase traffic flow theory to study the relationship. We analyzed data which collected from weaving area of different lanes, locations and times, and found the little relationship between density and lane-changing behaviors. And then, regression modeling and clustering analysis method was used to study the relationship. We found that the regression modeling method couldn't establish a better model, but cluster analysis method could. So we established the Four-phase density – lane-changing model to better describe the relationship between density and lane-changing behavior on the road with a large number of lane-changing behaviors. In the future, we will study the usability of the model in other roads.

Key words: urban expressway; density; lane-changing behavior; cluster analysis

基于手机信令数据的城市轨道客流路径识别方法
——以南京地铁为例

于泳波，程晓明
（南京市城市与交通规划设计研究院股份有限公司）

摘 要：基于南京移动提供的全市手机信令数据，结合南京城市轨道网络 GIS 数据、列车运营时刻表数据，通过将用户轨迹映射到轨道站点，抽取用户在轨道网络上的轨迹。在此基础上，对轨道网络任意站间 OD 预设可能的备选路径集，与手机数据识别出的站点轨迹进行相似度计算，匹配到最有可能的出行路径，作为用户在轨道网络中的实际出行路径。通过与南京地铁官方提供的数据校核，验证了方法的可靠性。

关键词：手机信令数据；城市轨道交通；路径集；相似度

Path Recognition Method of Urban Rail Passenger Flow Based on Mobile Signaling Data: A Case Study of Nanjing Metro

Yu Yongbo , Cheng Xiaoming
（Nanjing Institute Of City & Transport Planning Co..Itd）

Abstract:
Based on the mobile phone signaling data provided by Nanjing Mobile, combined with the Nanjing Urban Rail Network GIS data and train operation timetable data, users' trajectories are mapped to the rail stations to extract users' trajectories on the rail network. On this basis, the OD preset possible alternative paths set between any stations in the rail network are calculated to match the most likely travel paths with the station trajectories identified by mobile phone data, which can be used as the actual travel paths of users in the rail network. The reliability of the method is verified by checking the data provided by Nanjing Metro.
keywords: key words: mobile phone signaling data; urban rail transit; path set; similarity

作者简介：于泳波，南京市城市与交通规划设计研究院股份有限公司，magic1992yu@163.com。

The Pattern of Non-Round Trip Travel on Urban Rail and Its Application in Transit Improvement

Xi Yang
Wang Zijia
Beijing Jiaotong University
243533393@qq.com

Abstract: Transit smartcards record detailed travel information of passengers, which provides abundant data for analysing public travel patterns. Most studies that use smartcard data (SCD) have emphasised roundtrip travel, which can reveal many hidden laws, while non-roundtrip travel has seldom been addressed. In metropolises such as Beijing, non-roundtrip travel accounts for a relatively large portion of the overall transit ridership. This study has focused on passengers who took non-roundtrip travel on the metro system during a day in order to reveal the travel pattern of this kind of trip. We have used 1 week of SCD and concentrated on non-roundtrip travel to analyse the changes in the number of trips made by a cardholder on different days of a week and the spatiotemporal distribution patterns of typical origins and destinations (ODs). To further reveal the reasons that people make frequent non-roundtrip travel, we have combined metro data with bus data and visualised the results with a geographic information system (GIS). The results demonstrated that, although non-roundtrip travel was caused by occasional demands, some spatiotemporal patterns could be detected. For instance, some passengers were forced to take an alternative bus line to avoid incredibly crowded situations for one leg of a roundtrip, while others enjoyed the directness of the bus line compared to its metro counterpart. This research could provide some scientific suggestions for more deeply understanding the travel patterns of metro trips and developing appropriate demand management measures.

Key words: metro; smartcard data; non-roundtrip travel; spatiotemporal pattern

居住区泊位共享意愿研究

马丹辉
（长安大学）

摘　要：为了研究居住区私家泊位所有者的共享意愿，借助 RP 和 SP 调查，通过定性与定量相结合的方式，对泊位所有者共享意向的影响因素进行了深入分析，根据调查结果提取出与共享意向相关性较强的因素并构建基于 logistic 的共享意向概率模型，得到年龄、月收入水平、小区位置、小区周边停车状况、惩罚机制、安全性六个因素与私家泊位所有者的共享意愿之间有显著的影响作用的结论。对居住区泊位共享策略的制定具有很大的借鉴意义。

关键词：交通管理；泊位共享；logistic

Research on the Willingness of Parking Sharing in Residential Areas

Ma Dan Hui
（Chang'an University）

Abstract:

In order to deeply analyze the sharing intention of the owners of private berths in residential areas, with the help of RP and SP surveys, various related factors affecting the sharing intention of the owners of berths are deeply analyzed by combining qualitative and quantitative methods. Based on the survey results, the factors with strong correlation with the sharing intention are extracted and the probability model of sharing intention based on logistic is constructed. And age, monthly income level, location, parking conditions, penalty mechanism and security have significant influence on the willingness of private parking owners. It has great reference significance for the formulation of berth sharing strategy in residential areas.

keywords: traffic management; berth sharing; logistic

作者简介：马丹辉，长安大学，413755387@qq.com。

Civil Information Modeling(CIM) Trend in Transportation

BU shanshan
China
长安大学公路学院
bssglxy@chd.edu.cn

Abstract： CIM in general understanding, is the civil information modelling in common use. Before the concept appeared in the research field, BIM as known as building information modelling, is mainly involved in ‘construction industry information standard system and key standards research’ and ‘BIM technology based next-generation building engineering application research’. The predicted achievements of these studies in the field of transportation engineering are: risk management, organization management, equipment management, and most importantly, information management. In this paper, CIM concepts in the field of transportation are mainly introduced. This paper would firstly discuss the BIM application in transportation, then have a related forecast on the CIM trend in transportation complied with the BIM research in transportation.

Key words： Transportation; Civil Engineering; BIM; CIM

基于多源数据融合技术的江苏省过江特征及交通量分析

周涛，邓润飞，张雪琦
（中设设计集团）

摘　要：为了支撑江苏省过江通道建设，摸清机动车过江现状，了解过江出行特征，江苏省开展了全省机动车 OD 调查。本调查结合交通行业数据、问卷数据和手机信令大数据等调查多种手段，获得不同类型的多源异构数据；根据数据特点，对多源数据进行剔除、整理、融合、归并和统一等处理，按需求形成机动车 OD 矩阵和出行特征，最后利用 GIS、Python 和 Echart 进行可视化展示。本调查成功将多源数据融合技术应用到区域性 OD 调查中，大大提升了调查效率和全面性；确定了数据融合扩样的规则，形成了全套数据融合处理技术。而且，调查形成了 OD 对与出行特征对应的属性表，研究不同 OD 对间客货运量与出行特征的关系，发现交通量与区域经济结构、产业分布、城市特色、过江通道类型等都有着密切的关系。

关键词：过江通道；手机信令；多源数据

Analysis of Jiangsu River Crossing Characteristics and Traffic Volume Based on Multi-Source Data Fusion Technology

Zhou Tao, Deng Runfei, Zhang Xueqi
（中设设计集团）

Abstract:

In order to understand the current cross-river transportation condition and its characteristics, an Origination and Destination distribution (OD) vehicle traffic survey has recently been organized in Jiangsu Province to support the following planning and construction of cross-river channels. This survey generates multi-source in various types and structure based on statistical data, questionnaire data, and cellular signaling data. The vehicle OD matrix and traveling attributes has been built by culling, sorting, fusion analysis, and merging on multi-source data. The result of the survey and following data analysis has been visualized by GIS, python, and Echart tools. The survey and its following analysis successfully applies multi-source data fusion method into regional Origination and Destination distribution survey, improves the efficiency and comprehensiveness of traffic survey, and sets up the rule for data fusion and sampled data expansion. The research on the relationship between traveling attributes and passenger/freight volume in OD pair illustrates the correlation between traffic and regional economy structure, industry distribution, city characteristic, and type of cross-river channels.

keywords: pathway crossing rivers; Cell phone signaling; Multisource data

作者简介：周涛，中设设计集团，572022080@qq.com。

基于收费数据的高速公路断面交通流特性分析

焦港欣，张俊峰，杨灿
（北京航空航天大学 北京航空航天大学 北京航空航天大学合肥创新研究院）

摘　要：高速公路交通流特性分析是交通流理论研究的核心，基于高速公路收费数据进行数据挖掘，并对其表现出的交通特性进行深度分析，具有十分重要的现实意义。基于此，本文从实际收费数据提取基本交通参数，并以此为基础进行高速公路的不同车型出行规律分析，接着进行断面流量时空分布特性的分析，最后基于 SPSS 进行混合流车速分析。

关键词：高速公路；收费数据；交通流特性分析

Characteristic Analysis of Highway Section Traffic Flow Based on Toll Data

Jiao Gangxin, ZhangJunfeng, Yang Can
（Beihang University Beihang University 北京航空航天大学合肥创新研究院）

Abstract:

Characteristic analysis of highway traffic flow is the core of traffic flow research. It is of great practical significance to conduct data mining based on highway toll data and to analyze the traffic characteristics. Based on the above, this paper extracts the basic traffic parameters from the actual toll data, then carry out further analysis, including the travel patterns of different vehicle types of the highway analysis, the time and space distribution characteristics of the cross-section flow analysis, and finally the mixed-flow speed analysis based on SPSS analysis.

keywords: highway; toll data; traffic flow characteristics analysis

作者简介：焦港欣，北京航空航天大学，m15605696970@163.com。

基于 DBSCAN 聚类的高速公路路网运行状态判别分析

杨阳，张俊峰，杨灿

（北京航空航天大学 北京航空航天大学车路协同与安全控制北京市重点实验室 北京航空航天大学合肥创新研究院）

摘　要：目前，我国高速公路发展迅速，交通系统智能化和信息集成化水平不断提高，交通信息采集设备收集了海量的交通数据，但并没有对数据进行充分的分析研究，高速公路路网运行状态也没有一个较为完善的基于交通大数据的判别方法。为此，本文提出了一种基于 DBSCAN 聚类的高速公路路网运行状态判别分析方法，并且从高速公路路网和城市区域路网两个角度分析了路网运行状态判别的交通参数选取，以及依据海量数据下故障数据的识别和处理方法。基于 DBSCAN 聚类的方法中，研究不同路段断面流量曲线的相似度，通过构建相似度矩阵，选择离散弗雷歇距离作为测度研究曲线分类的方法，得到流量曲线的分类结果，实现对高速公路路段的运行状态判别。最后以安徽省的高速路网收费数据为例，对本文所构建的路网运行状态判别方法进行实例分析，通过不断调整和优化初始参数，得到了三类典型的路网流量曲线，验证结果表明本文的分类结果是合理的。

关键词：DBSCAN 聚类；断面流量；曲线相似度

Research on Traffic State Identification of Highway Network Based on DBSCAN Clustering

Yang Yang, Zhang Junfeng, Yang Can

（Beihang University 北京航空航天大学车路协同与安全控制北京市重点实验室 北京航空航天大学合肥创新研究院）

Abstract:

With the development of Highway, Traffic information collection equipment collects a large amount of traffic data, but there is no sufficient analysis and research on the identification of traffic state based on traffic big data. This paper proposes a method based on DBSCAN clustering for the analysis of the traffic state of highway road network, and analyzes the selection of traffic parameters for the identification of the traffic state both considering highway network and urban regional road network. We also proposed a method to identificate and deal with fault data. Based on the DBSCAN clustering method, we studied the similarity of the section flow curves by constructing the similarity matrix,choosing Frescher distance as the method of measuring the curve classification, and the classification result of the flow curve is obtained to realize the highway traffic state. Finally, our paper carried out am example analysis based on the highway charging data of Anhui Province. Through continuously adjusting and optimizing the initial parameters, three typical road network traffic curves are obtained, and the actual traffic is utilized. The curve verification results show that the classification results and our method in this paper are reasonable.

keywords: DBSCAN clustering; Section flow rate; Curve similarity

作者简介：杨阳，北京航空航天大学，961879274@qq.com。

二十一世纪初中国交通运输系统的发展研究

郭瑞军，张佳垚，刘珊
（大连交通大学）

摘　要：依据我国近二十年来的统计年鉴、统计公报等文献，得到我国交通运输行业各指标数据，进行了纵向的统计分析，并就美国、日本等国的交通运输数据与我国做横向对比分析，探讨了21世纪初我国交通运输系统的发展特点、趋势及存在问题，并提出相关的发展对策。研究表明：我国公路、铁路里程规模持续扩大，重点发展了复线铁路、电气铁路和高等级公路建设；加强了对港口的质量建设，加大对万吨级深水泊位的投资力度；我国货运以水运、公路、铁路为主，其中水运占据主导地位，航空运输所占份额很低；客运以铁路、公路和航空为主，其中航空运输增长最为迅速，水运运输在客运方面并呈逐年下降趋势；从路网密度和机场密度来看，我国交通运输基础设施与美国、日本相比，仍然处于落后水平。我国客货运周转量在世界范围内均已达到相当大的规模，货运优势明显。基于上述交通发展现状，我国应该加强交通设施建设，尤其是继续完善高速公路网建设和农村公路的覆盖；大力发展航空业基础设施建设，努力提高中小城市的航空通达性；继续加强万吨级泊位建设，提高我国港口的吞吐能力；根据各交通方式适应性特点，发挥各交通方式在不同距离客货运输的优势，提高我国客货运输能力。

关键词：交通运输系统

Study on Transportation System of China at the Beginning of the 21st Century

Guo Ruijun, Zhang Jiayao, Liu Shan
（Dalian Jiaotong University）

Abstract:

Thesis mainly from the statistical bulletin and other statistical data in recent years in our country, and make statistical analysis of vertical investigation relevant indicators, and a horizontal statistical analysis was made after surveying the transportation indicator values of the United States, Japan and China, find out the development characteristic of transportation system in China and the existing problems, and put forward related development countermeasures. Studies have shown that: the transportation to continue to develop public transportation, developing high efficiency and energy saving mode of transportation, especially the high-speed railway and highway construction, and the freight is given priority to with water transport and railway transport; At the same time vigorously develop aviation infrastructure construction, especially the development of regional aviation; Play a role of China's inland waterway advantage to promote the development of waterway passenger transport optimization; All kinds of transportation must be coordinated development; Emphasis on intelligent transportation industry and the information construction, improve the level of traffic service and operational efficiency.

keywords: transportation system

作者简介：郭瑞军，大连交通大学，rjguo@163.com。

基于收费数据的高速公路交通流时空分布分析

王飞，郝杰，于海生，杨灿

（北京航空航天大学交通科学与工程学院 北京航空航天大学交通科学与工程学院 吉林省高速公路管理局 北京航空航天大学合肥创新研究院）

摘　要：高速公路是我国路网的重要组成，在运输能力和安全性方面具有重要优势，对于缩小地区差距，实现均衡发展，提高现代物流效率具有重要意义。本文在对吉林省高速公路收费数据进行预处理的基础上分析了高速公路交通流的时空交通分布特性，其中时间分布特征包括车辆组成特征、交通量时间变化特征、旅行时间分布特征，空间分布特征包括交通量网络分配、旅行距离分布特征及行驶方向分布特征，并对旅行距离和旅行时间进行了分布检验。

关键词：收费数据，高速路网，时空分布

Temporal and Spatial Distribution Analysis of Expressway Traffic Flow Based on Toll Data

Wang Fei , Hao Jie, Yu Haisheng, Yang Can

（Beihang University　Beihang University Jilin Provincial Expressway Administration Bureau 北京航空航天大学合肥创新研究院）

Abstract:

The expressway is an important component of China's road network. It has important advantages in terms of transportation capacity and safety. It is of great significance for narrowing regional gaps, achieving balanced development and improving modern logistics efficiency. Based on the pre-processing of expressway toll data in Anhui Province, this paper analyzes the temporal and spatial traffic distribution characteristics of expressway traffic flow. The time distribution features include vehicle composition characteristics, traffic volume time variation characteristics, travel time distribution characteristics, and spatial distribution characteristics. It includes traffic network distribution, travel distance distribution characteristics and driving direction distribution characteristics, and the distribution test of travel distance and travel time.

keywords: toll data, highway network, space-time distribution

作者简介：王飞，北京航空航天大学交通科学与工程学院，2574926325@qq. com。

大数据时代居民出行调查扩样技术研究

陈先龙
（广州市交通规划研究院）

摘　要：分析了居民出行调查对城市居民出行特征解析的误差成因。对利用传统调查和大数据方法开展居民出行调查的优缺点进行了对比分析，提出了结合二者优点的校核扩样模型设想。设计了利用人口普查数据、样本数据和大数据方法对城市实有人口计算模型框架，测算了广州市城市实有人口。以广州新一轮交通综合调查为例，介绍了基于志愿者 GPS 调查及基于手机信令出行活动分析的沉默需求挖掘模型，简要分析了其合理性。

关键词：居民出行调查；扩样；大数据；实有人口；沉默需求

Weighting and Expansion Study of Household Travel Survey in Big Data Era

Chen Xianlong
（Guangzhou Transport　Development　Annual　Report）

Abstract:

This paper explains what have caused the deviation between the real travel pattern and the characters’ index by household travel survey. Compared the advantages and disadvantages with traditional survey and Big Data, proposed a household travel survey weighting and expansion method which integrate of their merits. Devised a model framework to estimate the actual population which integrated census data, sample data and Big Data, estimated the actual population of Guangzhou. A data mine model of unreported trip record was proposed based on volunteer GPS survey and mobile phone signaling travel activity analysis, and briefly analyze its rationality with Guangzhou experience.

keywords: Household travel survey, Weighting and expansion, Big Data, Actual population, Unreported trip record

作者简介：陈先龙，广州市交通规划研究院，harleych@163.com。

山地城市交通状态评判标准研究——以重庆主城为例

刘丰杰，马庆禄，周琦
（重庆交通大学）

摘　要：为了提高交通状态评价方法及指标的准确性和适应性，在参考现有交通状态评价指标的基础上，结合山地城市特有交通运行特征，根据车道数、信号灯数以及坡度等参数划分道路，以相对道路的运行状况为评判方法，获得更为契合的交通评判结果。实验选择典型山地城市代表重庆城市道路网为原型，以浮动车技术配合干线视频录像以及人工调查的方法采集主城区不同道路类型的交通运行数据，利用回归分析法拟合交通状态，再分析给定路段交通影响因素对交通状态的影响并求出行程车速；从不同道路等级和信号灯影响因素两个方面划分不同状态区间的自由流车速，通过与行程车速比较，求出不同自由流类别下的交通状态区间，对各区间做出拥堵标准评判。

关键词：拥堵评价指标；交通状态评判；自由流车速；行程车速；浮动车数据

Research on Evaluation Criteria of Traffic State in Mountainous Cities Taking Chongqing as an Example

Liu Fengjie, Ma Qinglu, Zhou Qi
（Chongqing Jiaotong University）

Abstract:

In order to improve the accuracy and adaptability of traffic condition evaluation methods and indicators, on the basis of referring to the existing traffic condition evaluation indicators, combining with the unique traffic operation characteristics of mountainous cities, roads are divided according to the number of lanes, the number of signal lights and the slope, and the relative road operation status is taken as the evaluation method to obtain better results. Corresponding traffic evaluation results. The experiment chooses the typical mountain city representative Chongqing urban road network as the prototype, collects the traffic operation data of different road types in the main urban area by floating car technology combined with trunk video and manual investigation, fits the traffic status by regression analysis method, and then analyses the influence of traffic factors on the traffic status of a given section. It divides the free-flow speed of difference of different state intervals from two aspects of different road grades and signal factors, and compares the free-flow speed with the travel speed to find out the traffic state intervals under different free-flow categories, and makes the congestion standard evaluation for each interval.

keywords: congestion evaluation index; traffic condition evaluation; free flow speed; travel speed; floating vehicle data

作者简介：刘丰杰，重庆交通大学，1419172427@qq.com。

基于出行者选择的城市公交网络连通满意度评价

王成
（上海市城市建设设计研究总院（集团）有限公司）

摘　要：公交网络的连通性是评价公交服务能力的重要指标。现有研究从规划者的角度基于公交网络的拓扑结构度量网络的连通性，没有考虑公交出行者的出行感受等因素对网络连通性度量的影响，导致度量的公交网络连通能力与公交乘客的实际感受不一致。本文从公交出行者的角度提出新的方法，度量出行者对于公交网络所提供的连通能力的满意度。通过矩阵形式建立公交站点间的拓扑连接关系，并通过矩阵运算获得不同换乘情况下区域内公交站点的换乘连接情况。以公交网络中拓扑连接的站点对作为研究对象，使用公交车载 GPS 数据和公交地理信息数据确定不同时段站点间的公交出行效率，以出行者对公交出行效率的最低期望作为阈值判定站点间的连通状态。以实现连通的站点对数占实际连接的站点对数的比例作为评价出行者对公交网络连通满意度的量化指标。应用本方法度量哈尔滨市平房区公交线网的连通满意度，结果表明：（1）基于本方法获得的网络连通性指标可以描述出行者实际感受到的网络连通程度；（2）基于本方法可获得不同比例公交出行者对网络的连通满意度，具有动态评价的特点；（3）基于本方法可获得不同时段的公交网络的连通满意度，能反映公交网络的时变特征。

关键词：公交网络；连通性；GPS 数据；出行效率

Evaluation of Bus Network Connectivity Satisfaction Based on Traveler Selection

Wang Cheng
（Shanghai Urban Construction Design Research Institute (Group) Co., Ltd）

Abstract:

The connectivity of bus networks is an important index for evaluating the ability of bus service. The previous researches based on the topological structure of the bus network to measure bus network connectivity from the perspective of bus network planners，but the impact of factors such as the travel experience of passengers on the measurement of network connectivity are not considered, lead to the measured connectvity of bus network is inconsistent with the actual feelings of bus passengers. This paper presents a new method from the perspective of bus passengers, to measure the satisfaction of travellers with the connectivity provided by the bus network. The topological connection relation between bus stations is established through the matrix form, the transfer connection of bus stations in the region under different transfer conditions is obtained through matrix calculation. The topologically connected station pair in bus network is taken as the research object, bus GPS data and bus network geographical data are used to calculate the bus travel efficiency between stations at different time periods, and the minimum expectation of the traveler for the efficiency of bus travel is used as the threshold to judge the connectivity between stations. Finally, the ratio of the number of connected stations to the number of topologically connected stations is taken as a quantitative index to evaluate the travelers’ satisfaction with the connectivity

provided by bus network. The new method is applied to measure the connectivity satisfaction of bus network in PingFang District of Harbin. The results show that: (1) The network connectivity index based on this method can describe the travelers' actually feeling of network connectivity; (2) The satisfaction of different proportion of bus travelers to the network connectivity can be obtained, which has the characteristics of dynamic evaluation; (3) The connectivity satisfaction of bus network in different time periods can be obtained, which can reflect the time-varying characteristics of bus network.

keywords: bus network; connectivity; GPS data; travel efficiency

作者简介：王成，上海市城市建设设计研究总院（集团）有限公司，wangcheng@sucdri.com。

基于手机大数据的高速公路路网运行评价系统

陆俊贤
（上海云砥信息科技有限公司）

摘　要：本文利用手机大数据获取高速公路的交通运行状态数据，搭建了一套基于手机大数据的高速公路路网运行评价系统，成功应用于浙江省交通运输厅，从不同时间维度、不同空间范围分析评价路网运行指标，并针对重大节假日、常发拥堵、事件影响开展专题分析，实现多角度、深层次、系统性地分析评价高速公路路网的运行情况，为交通管理部门进一步做好路网运行监测、突发事件应急处置和公众出行信息服务提供了重要的数据支撑与决策支持。

关键词：智能交通系统；手机大数据；高速公路路网；运行评价智能交通系统；手机大数据；高速公路路网；运行评价

An Operation Evaluation System for Freeway Network Based on Mobile Big Data

LU Junxian
（Shanghai SinoCloudBase Information Technology Co.,Ltd.）

Abstract:

This paper studies an operation evaluation system for freeway network based on mobile big data. It has been successfully applied to the Zhejiang Provincial Department of Transportation. The system analyzes and evaluates road network operating indicators from different time dimensions and different spatial ranges, it has thematic analysis, including major holiday analysis, frequent congestion analysis, and event impact analysis. The system can implement multiple angles, in-depth, and systematic evaluations of the operation of the freeway network, it provides important data support and decision support for the traffic management department to further complete the road network operation monitoring, emergencies emergency response and public travel information services.

keywords: ITS; mobile big data; freeway network; operation evaluation

作者简介：陆俊贤，上海云砥信息科技有限公司，1024687393@qq. com。

高速铁路、人口流动与企业绿色技术创新

李玥
（长江大学）

摘　要：本文以长江经济带 110 个城市为例，运用双重差分法，通过 GMM 估计模型研究高铁一线城市可达性对绿色技术创新的影响以及高铁对不同城市科技从业者的溢出效应。研究发现在长江经济带核心城市和中小城市，高铁可达性普遍与绿色技术创新成正比，但是这种促进并非通过科技从业者的增加，而是通过技术的引进和扩散，相反，高铁可达性增强造成了科技从业人员向一线城市流出，而城市工资水平是加大科技从业人员吸引力的重要途经。研究为各地区高铁规划与建设及其合理利用提供参考性建议。

关键词：高速铁路；绿色技术创新；长江经济带；双重差分法；GMM 估计

Research on The High Speed Railways, Movement of Population and Green Technology Innovation in Enterprise

LI Yue
（长江大学）

Abstract:

The construction of high-speed railway is a revolutionary progress in transportation mode. In recent years, China's high-speed railway has been built rapidly, and the accessibility of urban high-speed railway has been strengthened, which has reduced the difficulty of inter-city personnel and technology flow, shortened the time distance between cities, and changed The concept of commuting has broken the barriers of technical exchanges between cities. Taking 110 cities in the Yangtze River Economic Belt as an example, this paper uses the Difference in differences method to study the impact of high-speed rail first-city accessibility on green technology innovation and the spillover effect of high-speed rail on science and technology practitioners in different cities. The study found that in the core cities of the Yangtze Economic Zone and small and medium-sized cities, the accessibility of high-speed rail is generally proportional to green technology innovation, but this promotion is not through the increase of technology practitioners, but through the introduction and diffusion of technology. Sexual enhancement has caused technology practitioners to flow out to first-tier cities, and urban wage levels are an important way to increase the attractiveness of technology practitioners. Research provides reference recommendations for high-speed rail planning and construction in various regions and their rational use.

keywords: high speed railways; Green technological innovation; Yangtze Economic Zone; Difference in differences; Generalized method of moments

作者简介：李玥，长江大学，liyueluna@sina.com。

信息条件下城市出租车乘客等待时间测算模型

吕明，曹祎，罗霞
（四川省交通运输厅公路规划勘察设计研究院）

摘　要：打车软件使信息条件下的城市出租车运营特征明显区别于传统巡游模式，为了准确测算出在此信息条件下出租车乘客的等待时间，本文首先由交通小区实载出租车的到发量关系将各小区划分为饱和、平衡及不饱和小区，然后考虑信息条件对空驶出租车搜索行为的影响以预测出空驶出租车分布矩阵，最终根据出租车的单次空驶时间与乘客单次等待时间守恒关系构建出各小区乘客的平均等待时间模型。在数值实验中，在同一网络里与传统背景下均衡模型对比可知打车软件对不同小区的乘客等待时间影响不同。对于饱和及平衡小区，乘客单次平均等待时间缩短了 65%，对于未饱和小区乘客单次平均等待时间增加了 23%~58%，同时该区域出租车空驶率降低。计算结果表明，打车软件能增强信息透明度，降低出租车空驶率，对乘客等待时间有一定的影响，可提供对打车软件的引导及管理的决策依据。

关键词：交通工程；出租车运营网络；打车软件；乘客等待时间；空驶率；信息条件

The Taxi Passenger Waiting Time Calculating Model Under Information Condition

Lv Ming ,Cao Yi , Luo Xia
（Sichuan provincial transport department highway planning, survey, design and research institute,）

Abstract:

The operation characters of urban taxis were distinguished from traditional cruise service mode under information condition by taxi-hailing apps. In order to calculate average passenger waiting time in each zone, the traffic zones were divided into saturation zone, unsaturation zone and equilibrium zone according to the relationship of arrival and departure quantity of load taxis firstly. And considering the effect produced by information condition on searching behavior, the vacant taxi trip distribution could be obtained. Finally, the model of passenger waiting time under information condition was proposed. The example showed that the change of passenger waiting time varied from zone to zone. The passenger waiting time reduced by 65% in saturation zone and equilibrium zone, and it increase by 23% to 58%. Meanwhile, taxi unloaded ratio under information condition reduced. The result revealed that taxi-hailing apps contributed to information transparency and made effect on passenger waiting time and unload ratio, which can reflect reality of operation efficiency and offer some beneficial guidance and theoretic basis to the planning and management of urban taxi-hailing apps.

keywords: traffic engineering; taxi service network; taxi-hailing apps; passenger waiting time; taxi unload rate; information condition

作者简介：吕明，四川省交通运输厅公路规划勘察设计研究院，tiger_lvming@foxmail.com。

小城市绿色交通评价方法与指标体系研究

刘光新
（江苏省城市规划设计研究院）

摘　要：绿色交通评价指标体系是客观评估一个城市绿色交通发展水平的测量手段，同时也是深入剖析现状存在问题和提出未来改进方向的指引。本文以盱眙县为例，在总结现阶段小城市绿色交通发展存在问题基础上，探讨小城市绿色交通评价方法与指标体系。建议小城市绿色交通指标体系由绿色交通出行比例、城市道路建设水平、公共交通设施便利化、智能交通系统发展水平、新能源汽车普及率等指标组成。采用加权平均法对各评价指标进行综合评价，并确定各评价子指标的分级评价标准，对盱眙县现状、2020 年及 2030 年规划方案进行了综合评价。以评价结果为工具分析盱眙县主要存在的问题，最后提出小城市绿色交通改善建议：一是大力发展公共交通；二是确实落实“窄马路、密路网，开放街区” 战略，避免“宽马路+大街区”的规划和开发模式；三是加大新能源汽车政策和资金投入，四是定期进行目标考核。

关键词：小城市；绿色交通；评价方法；指标体系；慢行交通

Study on Evaluation Method and Index System of Green Transport in Small Cities

Liu Guangxin
（Jiangsu Institute of Urban Planning and Design）

Abstract:

The evaluation index system of green transport is a measure to objectively evaluate the development level of a city's green transport. It is also a guide to deeply analyze the existing problems and put forward the direction of future improvement. Taking Xuyi County as an example, this paper summarizes the problems existing in the development of green tranport in small cities at present, and discusses the evaluation method and index system of green transport in small cities. It is suggested that the index system of green transport in small cities should be composed of green transport travel ratio, urban road construction level, public transport facilities convenience, intelligent transportation system development level and new energy vehicle popularity rate. The weighted average method was used to evaluate each evaluation index comprehensively, and the grading evaluation criteria of each evaluation sub-index were determined. The current situation of Xuyi County, the plan for 2020 and 2030 were evaluated comprehensively. The main problems in Xuyi County are analyzed with the evaluation results as a tool. Finally, suggestions for improving green transport in small cities are put forward. Firstly, we should vigorously develop public transport; secondly, we should implement the strategy of "narrow road, dense road network, open blocks" to avoid the planning and development mode of "wide road + street area"; thirdly, we should increase the policy and investment of new energy vehicles; fourthly, we should regularly carry out target assessment. Firstly, we should vigorously develop public transport; secondly, we should implement the strategy of "narrow road, dense road network, open blocks" to avoid the planning and

development mode of "wide road + superblock"; thirdly, we should increase the policy and investment of new energy vehicles; fourthly, we should regularly carry out target assessment.
keywords: small cities; green transport; evaluation method; index system; slow traffic

作者简介：刘光新，江苏省城市规划设计研究院，gxin1999@163.com。

基于模糊隐马尔科夫模型的交通状态判别

胡郁葱，吴昊
（华南理工大学）

摘　要：对高速公路进行交通状态判别能为交通管理者和出行者提供准确的交通运行状态信息，提高高速公路的整体运行效率。针对现有方法的不足，充分考虑交通状态之间的转换关系和交通流参数与对应交通状态之间的映射关系，并引入模糊集的思想，构建了模糊隐马尔科夫交通判别模型，其中交通状态个数为 5，观测变量为流量，速度，时间占有率。为了验证提出方法的有效性，以美国加利福尼亚州高速公路 401195 号检测站为研究对象，选取 2012 年 6 月与 7 月两个月数据进行实例分析，结果表明，提出的方法能清晰地判别出 5 类交通状态，符合交通流基本理论和人的主观认知。

关键词：交通工程；交通状态判别；模糊隐马尔科夫模型

Traffic State Identification Based on Fuzzy Hidden Markov Model

Hu Yucong , Wu Hao
（South China University of Technology）

Abstract:

Traffic status identification of expressway can provide accurate traffic status information for traffic managers and travelers, and improve the overall operation efficiency of expressway. In view of the shortcomings of the existing methods, a fuzzy hidden Markov traffic discrimination model is constructed by fully considering the transition relationship between traffic states and the mapping relationship between traffic flow parameters and corresponding traffic states, and introducing the idea of fuzzy sets. The number of traffic states is 5, and the observed variables are traffic flow, speed and time occupancy. In order to verify the validity of the proposed method, taking 401195 test station of California Highway as the research object, the data of June and July 2012 are selected for example analysis. The results show that the proposed method can clearly distinguish five types of traffic states, which accords with the basic theory of traffic flow and human subjective perception.

keywords: traffic engineering; traffic state identification; fuzzy hidden markov models

作者简介：胡郁葱，华南理工大学，ychu@scut.edu.cn。

大数据环境下城市公共交通发展指数分析

张姚，蒋阳升
（西南交通大学）

摘　要：针对大数据环境下数据来源多样、信息交错等特点，建立城市公共交通发展指数指标体系，评价其发展水平，为城市规划、管理者提供科学有效的信息。首先从系统评价指标建立的理论依据和指标构建原则考虑，以公交都市考核指标为参考，从交通基础设施配备水平、公交运营服务质量、公共交通可持续发展水平三个方面进行评价指标的建立，初步探讨了评价指标的分级标准；接着比较几种常用评价方法的特点及适用环境，确定基于改进的模糊层次分析法确定指标权重和基于加权算法确定评价等级的公共交通系统发展指数综合评价方法；最后对成都市公共交通发展水平进行实例分析，验证了该评价指标体系的科学、合理性。

关键词：城市公共交通；评价指标体系；改进模糊层次分析法

Analysis of Urban Public Transportation Development Index Under Big Data Environment

Zhang Yao, Jiang Yangsheng
（Southwest Jiaotong University）

Abstract:

In view of the diversity of data sources and information interlacing in the big data environment, the index system of urban public transportation development is established to evaluate its development level and provide scientific and effective information for urban management. Firstly, considering the theoretical basis and the principle of index construction, the evaluation indicators of traffic infrastructure, the quality of public transportation operation, and the sustainable development level of public transportation are considered to establish the evaluation indicators. The grading standards of evaluation indicators are preliminarily discussed. Then, the characteristics and applicable environment of several commonly used evaluation methods are compared. The comprehensive evaluation method of public transportation system development index based on improved fuzzy analytic hierarchy process to determine index weights and weighted algorithm to determine evaluation grades is determined. Finally, an example analysis of the development level of public transportation in Chengdu is carried out to verify the scientific and rationality of the evaluation index system.

keywords: urban public transportation; evaluation indicator system; modified fuzzy analytic hierarchy process

作者简介：张姚，西南交通大学，1530496857@qq.com。

Development and AHP Based Comparison of Bike-Sharing Systems in China

Wang Lin
Shandong Transportation Institute
2271134733@qq.com

Wei Zhonghua
Beijing University of Technology

Qiu Shi
Beijing University of Technology

Feng Qi
Shandong Transportation Institute

Abstract: The transportation mode has been changing rapidly with the development of technology in China. In recent years, with the explosive growth of the automotive vehicles in big cities, the related environmental problems have become the center of public concern. Government has been advocating Green transportation and low-carbon travel modes in order to decrease urban traffic pressure and solve environmental problems. The innovative mobile internet based bike sharing system(BSS) with no fixed station motivates the return of bicycle to cities since 2016. The total number of sharing bicycles in China has reached 4 million till April 2017. On the other hand, along with the booming sharing bicycles, emerging operation and management problems such as parking and safety issues hinder the development of the whole transportation system. In this study, different bike sharing systems (BSSs) in Beijing are compared and evaluated from three aspects: service level, operation efficiency and social effects respectively. Analytic Hierarchy Process (AHP) is used to determine the weight of 14 indicators for the BSS evaluation framework, and multi-level fuzzy comprehensive evaluation method is used to appraise BSSs. Evaluation data are collected by using Delphi method and user satisfaction survey. The evaluation results indicate that Mobike and ofo, which are both provide by private operators outperform Beijing public bikes that are provided by the city municipal government in terms of the service level, especially under the convenience and comfort consideration, while Beijing public bike has economy advantage than private providers. This study also provides practical suggestions for the BSS operators, government, and the urban transport planners that it is necessary to establish a public private partnership mode to take the advantages of both private owned and municipal agency owned sharing bicycle systems.

Key words: bike-sharing systems, evaluation, service level, bike operation, social impact

基于多层次综合评价的公交运行瓶颈诊断

门玉宝，张箴言，王宝杰，沈照庆
（长安大学）

摘　要：运行瓶颈诊断对公交发车时刻表调整和车辆调度优化具有重要意义。从公交乘客和公交运营企业的不同关切点出发，结合公交 GPS 和 IC 卡等实时运营数据，提出一种公交运行瓶颈诊断方法。在公交企业运营效益、公交乘客出行效率等因素分析的基础上，分别从站点层面提出公交车头时距、车辆延误度等运行评价方法，在线路层面构建公交行程时间与运输效益评价方法，以及基于站点、线路评价结果的线网层面综合分析方法。最后，利用案例获取的公交车位置、行驶速度、公交乘客数量等实时数据，以及公交站点、线路、线网和调度方案等静态数据，对所提方法进行检验。结果表明，公交运行瓶颈诊断结果与公交实际运行状况具有较高符合度，能够实时、有效反应公交运行状态，具有较好的工程实用价值。

关键词：公交运行瓶颈；综合评价指标；乘客出行效率；企业运营效益

Bus Operation Bottleneck Diagnosis Based on Multi-Level Comprehensive Evaluation

Men Yubao , zhang Zhenyan, Wang Baojie, Shen Zhaoqing
（Chang'an University）

Abstract:

Operation bottleneck diagnosis is of great significance to bus schedule adjustment and vehicle scheduling optimization. Based on the different concerns of bus passengers and bus operation enterprises, and combined with real-time operation data such as bus GPS and IC card, a method of bus operation bottleneck diagnosis is proposed. In the enterprise operation efficiency of bus, bus passenger travel based on the analysis of the factors such as efficiency, respectively from the aspect of site bus is put forward the headway, vehicle delay degree evaluation methods, such as, at the line level build bus travel time and transportation efficiency evaluation method, and based on the site, track line network level comprehensive analysis method of evaluation results. Finally, the proposed method is tested with real-time data such as bus location, driving speed and number of bus passengers obtained from the case, as well as static data such as bus station, line, line network and scheduling scheme. The results show that the bus operation bottleneck diagnosis result has a high degree of conformity with the actual operation of the bus, and it can reflect the bus operation status in real time and effectively, and has good engineering practical value.

keywords: bus operation bottleneck; Comprehensive evaluation index; Passenger travel efficiency; Enterprise operation benefit

作者简介：门玉宝，长安大学，myb611@126.com。

Study on the Determination of Spatio-Temporal Threshold of Bicycle Connection Rail Transit in Haze Under Traffic Restriction

Wang Po (China)
Chang an university
1043144932@qq.com

Abstract: Urban rail transit accounts for an increasing proportion of the travel structure and becomes the backbone of the city. At present, the rapid development of urban shared bicycles provides favorable conditions for commuters to use bicycles to connect rail transit. This paper establishes the distance attenuation model and the non-aggregate price sensitivity measurement method under the influence of winter traffic restriction measures by studying the significant passenger flow using the bicycle to connect the rail transit of the Xi'an metro line 2 terminal Weiqu South Station. The RP and SP traffic survey data were used to analyze the impact of the restricted measures on the spatio-temporal threshold determination of the bicycle-connected rail transit, which provided a reference for the planners to formulate relevant plans for bicycle-connected rail transit.

Key words: Urban rail transit; Bicycle feeder; Distance attenuation model; Spatio-temporal threshold

基于 SEM 的高速公路服务区乘客满意度评价模型

余豪
（重庆交通大学）

摘　要：为解决高速公路服务区缺少从出行者主观感受角度定量描述满意度的问题，基于结构方程模型理论，构建了高速公路服务区乘客满意度评价模型，最后将模型运用到贵州省高速公路服务区乘客满意度研究的实例中，通过定性与定量分析了观察变量与潜变量之间的因素载荷值以及各潜变量对满意度之间的路径系数。结果表明各潜变量对满意度的影响大小分别为：硬件设施及其规模（0.48）、服务内容及价格（0.11）、环境及卫生（0.38）、信息咨询（0.08），此外，满意度对忠诚度的路径系数为 0.88。

关键词：交通运输；高速公路服务区；满意度；结构方程模型；服务质量

Passenger Satisfaction Evaluation Model of Expressway Service Area Based on SEM

Yu Hao
（Chongqing Jiaotong University）

Abstract:

in order to solve the problem that the factors affecting the passenger satisfaction degree of the expressway service area are quantified, the structural equation model (SEM) is introduced in this paper, and the passenger satisfaction evaluation model of the expressway service area is constructed. Finally, the model is applied to the example of the passenger satisfaction research in the Guizhou expressway service area. Through qualitative and quantitative analysis, we observed the factor load values between variables and latent variables, and the path coefficients between different latent variables to satisfaction. The results show that the impact of the latent variables on satisfaction is: hardware facilities and their scale (0.48), service content and price (0.11), environment and health (0.38), information consultation (0.08). In addition, the path coefficient of satisfaction to loyalty is 0.88.

keywords: Transportation; Highway Service Area; Satisfaction; Structural Equation Model; Service Quality

作者简介：余豪，重庆交通大学，252029796@qq.com。

基于广义出行费用的多校区出行分析

尚尔康，左忠义
（大连交通大学）

摘　要：本文通过对广义费用理论的研究，建立了涵盖两校区间的五种出行方式的广义出行成本模型，并且通过对随机效用理论的相关分析，利用广义出行成本函数变式改进 Logit 模型，对理想状态下的 D 大两校区之间的出行方式占比进行了计算，分析结果并提出了相应的改善意见。文章侧重对高校多校区之间的出行成本进行研究，以期对高校多校区之间的出行方式进行合理优化；希望通过合理分配各种交通方式的比重，降低出行成本，来达到对多校区高校的发展模式贡献出交通方面的力量的目的。

关键词：广义费用；多校区；随机效用理论；Logit 模型；出行分析

Multi-Campus Travel Analysis Based on General Travel Cost

Shang Erkang, Zuo Zhongyi
（Dalian Jiaotong University）

Abstract:

Based on the study of generalized cost theory, this paper establishes a generalized travel cost model covering the five modes of travel between two campuses of a university. Through the correlation analysis of the random utility theory, the generalized travel cost function variant is used to improve the Logit model. The ratio of the mode of travel between the two major campuses was calculated, and the results were analyzed and corresponding improvement suggestions were put forward. The article focuses on the study of travel costs between Multi-campuses, in order to rationally optimize the travel modes between two campuses of a university. Hoping to achieve a multi-campus university by rationally allocating the proportion of various modes of transportation and reducing travel costs. The development model contributes to the purpose of the power of transportation.

keywords: generalized cost; multi-campus; random utility theory; Logit model; travel analysis

作者简介：尚尔康，大连交通大学，381990374@qq.com。

基于 Logistic 模型的地铁乘客进站方式选择影响因素分析

宁静，王云，马超群
（长安大学）

摘　要：2017 年以来，我国各个城市的地铁站陆续开通了手机扫码进站的功能，此项举措为乘客出行提供了极大的便利。本文以西安市地铁乘客进站方式（手机扫码进站或刷卡进站）调查数据为基础，从地铁乘客的个人属性、出行目的、出行时段等方面分析了地铁乘客进站方式的选择偏好特征。在此基础上，以乘客选择的进站方式为因变量，初步选取 9 个候选自变量，建立了各因素对乘客进站方式影响概率的 Logistic 模型。结果表明年龄、出行目的、出行时段、一周内乘坐地铁次数对乘客选择进站方式有着显著影响。基于分析结果，掌握地铁乘客进站方式选择偏好特征，可为提升轨道交通闸机服务水平提供决策依据。

关键词：城市轨道交通；问卷调查；乘客特征；扫码进站；Logistic 模型

Analysis of Influence Factors of Subway Passengers' Mode Choice of Entering Station Based on Logistic Model

Ning Jing, Wang Yun, Ma Chaoqun
（Chang'an University）

Abstract:

Since 2017, the subway stations in various cities in China have successively opened the function of scanning QR code to enter the station. This measure has provided convenience for passengers. Based on the survey data of mode of Xi'an subway passengers entering the station (scanning code or swiping card), this paper analyzes the characteristics of subway passengers' preference for mode of entering station from the aspects of their personal characteristics, trip purposes and time periods. On this basis, the mode of passenger’s entering subway station was selected as the dependent variable, and 9 factors were selected as the candidate independent variables, and the Logistic model of the impact probability of various factors on the mode of passengers entering the subway station was established. The results show that age, trip purposes, time periods, and the frequency of subway rides in a week have significantly associated with the dependent variable. The research results can provide support for learning the preference characteristics of the passenger’s choice of entering the station and improving the service level of the rail transit gate machine.

keywords: Urban rail transit; Questionnaire Survey; Passenger characteristics; Scanning code to enter subway station; Logistic model

作者简介：宁静，长安大学，823628280@qq.com。

基于出租车 GPS 数据的居民出行热点区域研究

张鹏，吉柯
（长安大学）

摘　要：出租车作为城市公共交通的重要补充，在人们日常出行中起到越来越重要的作用。本文以西安市主城区为研究对象，根据出租车出行量分布和居民的出行时间段，将出租车出行划分为早高峰、晚高峰和夜高峰三个特征时段，运用基于密度的 DBSCAN 空间聚类算法对出租车上下客点进行聚类分析，挖掘出西安市主城区不同特征时段的载客热点区域，并结合 ArcGIS 工具实现载客热点区域可视化。研究结果表明，利用 DBSCAN 聚类算法能很好的识别和反映居民出行的热点区域。具体地，在早高峰时间段 6:00-7:30，载客热点区域主要集中在交通枢纽中心和办公区；在晚高峰时间段 17:00-18:30，载客热点区域相对分散，除了交通枢纽中心始终保持着大量的居民出行外，娱乐休闲区也形成了大量出行；在夜高峰时间段 20:30-22:00，载客热点区域分布更加零散和多样，分散在各种娱乐场所和商业区。

关键词：交通工程；出租车轨迹；空间聚类；热点区域

Research on Residents' Travel Hotspots Based on Taxi GPS Data

Zhang Peng, Ji Ke
（Chang'an University）

Abstract:

As an important supplement to urban public transportation, taxis are playing an increasingly important role in people's daily trips. This paper took the main city of Xi'an as the research object, according to the distribution of taxi trips and the travel time of residents, the taxi trips were divided into three characteristic periods including morning peak, evening peak and night peak. And then, the Density-Based Spatial Clustering of Applications with Noise (DBSCAN) algorithm was used to excavate the taxi pick-up hotspot areas at different feature periods of one day, the ArcGIS tool was used to realize the visualization. The research results show that the DBSCAN clustering algorithm can effectively identify and reflect the hotspots areas. Specifically, in the morning peak period 6:00-7:30, the hotspot areas are mainly concentrated in the transportation hub centers and office areas; In the evening peak period 17:00 to 18:30, the hotspot areas are relatively scattered, in addition to the transportation hub centers, the entertainment areas have also formed a large number of trips; During the night peak period of 20:30-22:00 , the hotspot areas are more scattered and diverse and distributed among the various entertainment and commercial areas.

keywords: traffic engineering; taxi trajectory; spatial clustering; hotspot area

作者简介：张鹏，长安大学，2017221136@chd. edu. cn。

基于 RP 与 SP 数据的实时信息对公交乘客路径选择的影响研究

陈明丽
（长安大学）

摘　要：为了探究实时交通信息下的公交乘客路径动态决策行为，发现乘客在 RTI 影响下的出行路径改变情况，首先，采用显示性偏好和意向性偏好调查方法对出行个体进行实地调查和网络调查。其次，根据问卷调查数据将乘客的属性进行分类，包括个人属性、对实时信息的使用情况、路径的动态决策行为。随后，借助 R 软件构建二元 Logistic 模型，辨识出各属性中具有显著性影响的因素作为主要变量，定量表示实时信息对改变乘客路径的影响情况。研究结果表明：公交乘客在实时信息的影响下，面临着多种路径选择情景，不同属性变量对乘客的路径选择影响存在差异。基于研究结果，掌握乘客的出行属性特征，分析乘客改变路径的概率，可为制定 RTI 等实时信息、提升信息的效益提供参考依据。

关键词：乘客出行路径

Research on the Influence of Real-Time Information Based on RP and SP Data on Bus Passenger Path Selection

Chen Mingli
（Chang'an University）

Abstract:

In order to explore the dynamic decision-making behavior of bus passengers under real-time traffic information, and to find out the changes of passengers' travel routes under the influence of RTI, firstly, the survey and the intentional preference survey method are used to conduct on-the-spot investigation and network survey. Secondly, the passenger's attributes are classified according to the survey data, including personal attributes, usage of real-time information, and dynamic decision-making behavior of the path. Then, using R software to construct a binary logistic model, the factors with significant influences in each attribute are identified as the main variables, and the influence of real-time information on changing passenger routes is quantitatively expressed. The research results show that under the influence of real-time information, bus passengers are faced with multiple path selection scenarios, and different attribute variables have different influences on passengers' path selection. Based on the research results, grasping the passenger's travel attribute characteristics and analyzing the probability of passengers changing the path can provide a reference for developing real-time information such as RTI and improving the efficiency of information.

keywords: passenger travel path

作者简介：陈明丽，长安大学，15659785223@163.com。

中心城与卫星城间通勤方式选择研究

陈伏，马超群，张辛煜
（长安大学）

摘　要：本文以 2015 年西安市居民出行调查为数据，分析了西安市中心城与卫星城间通勤者个人属性特征和出行属性特征，以通勤费用、行程时间、交通工具拥有状况以及性别为关键因素建立了主城区与卫星城间通勤方式选择的 Nested Logit 模型，模型的通勤方式分担率计算结果与实际分担率对比表明模型具有可行性；在此基础上应用模型研究了地铁票价水平对通勤方式分担率的影响，为西安地铁 9 号线票价水平决策提供理论参考。

关键词：卫星城；通勤方式；非集计模型；分担率；票价水平

Study on the Choice of Commuting Mode Between Central City and Satellite City

Chen Fu, Ma Chaoqun, Zhang Xinyu
（Chang'an University）

Abstract:

Based on the survey of residents' travel in Xi'an in 2015, this paper analyzes the characteristics of personal attributes and travel attributes of commuters between central city and satellite city of Xi'an. The Nested Logit model for the choice of commuting modes between central city and satellite city was established taking commuting cost, travel time, vehicle ownership and traveler gender as key factors. The comparison between the commutation mode sharing rate of the model calculation and the sharing rate of survey results indicates that the model is feasible. On this basis, the model is used to study the influence of the fare level of subway on the commuting mode sharing rate, and provide theoretical reference for the fare level decision of Line 9 of Xi'an Subway.

keywords: satellite city; commuting mode; non-aggregate model; share rate; fare level

作者简介：陈伏，长安大学，396120858@qq.com。

基于“行为心理学”的高速公路服务区设计研究

修学华
（中设设计集团股份有限公司）

摘　要：高速公路服务区作为高速公路中的服务驿站，设计时在满足服务区使用功能的同时，还需要关注旅客与建筑、环境之间的关系。本文以行为心理学为指导，从旅客的行为需求及使用感受出发，对现有服务区的设计进行优化，并为未来服务区的设计提供新的视角。

关键词：高速公路；服务区；行为心理学

Research on Expressway Service Area Design Based on Behavioral Psychology

Xiu Xuehua
（China Desigh Gruoup co.ltd.）

Abstract:
As the service station in the expressway, the expressway service area is designed to satisfy the use function of the service area, while it also needs to pay attention to the relationship between the passenger and the building and the environment. With the guidance of behavioral psychology, this paper optimizes the design of the existing service area and provides a new perspective for the design of the future service area, starting with the behavior needs and use feelings of the passengers.
keywords: Expressway; Service area; Behavioristic psychology

作者简介：修学华，中设设计集团股份有限公司，77767384@qq. com。

Forecasting Trip Purpose with Social Media Data and Google Places

Cui Yu ,Meng Chuishi,He Qing , Gao Jing
SUNY at Buffalo
cuiyu610@hotmail.com

Abstract: Trip purpose is crucial to travel behavior modeling and travel demand estimation for transportation planning and investment decisions. However, the spatial-temporal complexity of human activities makes the prediction of trip purpose a challenging problem. This research, an extension of Ermagun et al. (2017), has addressed the problem of trip purpose prediction with both Google Places and social media data. First, this paper implements a new approach to match Point of Interests (POIs) from Google Places API with historical Twitter data. Therefore, the popularity of each POI can be obtained. Moreover, a Bayesian neural network (BNN) is employed to model the trip dependence on each individual's daily trip chain and infer the trip purpose. Compared with traditional models, it is found that Google Places and Twitter information can greatly improve the accuracy of prediction. In addition, trip duration is found to be an important factor to infer activity/trip purposes. Further, to tackle the computational challenge in BNN, Elastic Net is implemented for feature selection before the classification task. Our research could lead to three types of possible applications, including activity-based travel demand modeling, survey labeling assistance, and online recommendations.

Key words: Bayesian neural network; Google Places; Social Media; Trip purpose prediction

基于高铁背景下的郑焦城际旅客出行行为特征分析

刘晓庆
（长安大学）

摘　要：本文通过问卷调查的形式对郑焦城际旅客的出行行为进行分析，通过对各交通方式的影响因素进行定量分析，构建效用函数模型和 Logit 模型，预测郑焦城际铁路和高速公路这两种运输方式的客流分担率，并对不同票价条件下城际铁路的客流分担率进行研究。结果表明，大多数城际旅客优先选择的出行方式是城际铁路，同时票价对客流分担率有一定影响。

关键词：城际出行；出行方式选择行为；出行特征分析；二项 Logit 模型；客流分担

Analysis of the Characteristics of Zhengzhou to Jiaozuo Intercity Passenger Traveling Behavior Based on High-Speed Rail Background

Liu Xiaoqing
（Chang'an University）

Abstract:

This paper analyzes the travel behavior of ZhengJiao intercity passengers through questionnaires, and quantitatively analyzes the influencing factors of each transportation mode, constructs a utility function model and a Logit model, and forecasts the ZhengJiao intercity railway and the expressway. The passenger flow sharing rate of the transportation mode, and the research on the passenger flow sharing rate of the intercity railway under different fare conditions. The results show that most of the intercity travelers prefer to travel by way of intercity railways, while the fare has a certain influence on the share of passenger flow.

keywords: intercity travel trip; mode selection behavior; travel characteristics analysis; two items Logit model; passenger sharing rate

作者简介：刘晓庆，长安大学，254727669@qq.com。

Consumer Adoption of Ridesourcing in China Comparison of Consumer Pre-Adoption and Post-Adoption Beliefs

Zhang Yingying , Llian Lian , Cao Li Huan, LI Jia Yu Maryna KIM
Changchun FAW International Logistics Co. Ltd
Dalian University of Technology
Zhejiang Geely Holding Group
Dalian Maritime University
zhangyingying_yqwl@faw.com.cn

Abstract: As a pattern of sharing economy, ridesourcing is booming in China with the spread of information and communication technology platforms. This paper originally proposes a user adoption model of ridesourcing based on the extension of technology acceptance model, which integrates external variables of system quality, perceived enjoyment, objective usability and perceived environmental friendliness. By data collection, a total of 562 valid self-administrated responses were collected through online and field survey including 250 experienced respondents and 312 inexperienced users separately. The SmartPLS was conducted to do measurement validation and test the structural model. The results indicated some similarities between two groups that attitude plays an important role to behavioral intention, and system quality, perceived enjoyment and perceived usefulness influence attitude positively. However, experienced customers care more about ease of use and potential users are more mindful to objective usability. This study enriches our understanding of people’ s adoption of ridesourcing in China, and makes a distinction between consumers' pre-adoption and post-adoption (continued use) beliefs and attitudes. These findings are promising to help mobility service enterprises outperform the competitors and get more users in market.

Key words : Sharing economic; ridesourcing; technology acceptance model; potential consumer; experienced consumer

基于决策树的居民出行方式影响因素分析

牛凯，张福明，陈宽民
（长安大学）

摘　要：作为城市交通规划、建设的依据，居民出行调查显得尤为重要。对于调查数据的挖掘分析可以为交通结构的改善及交通政策的制定提供一定参考。本文基于西安市 2015 年居民出行调查数据，对居民出行的影响因素进行分析。借助于 CART 算法，分别构建了长距离出行条件与短距离出行条件下的决策树模型。该模型结果表明：短距离出行条件下，出行目的为出行方式选择的主要影响因素，在此基础上，职业、年龄、是否开通公共自行车、出行时间对出行方式的选择进一步产生影响；在长距离出行条件下，年龄为出行方式的主要影响因素，性别、职业、有无公交卡、有无购车意愿、出行目的对出行方式的选择也会产生一定的影响。

关键词：决策树；CART；出行方式；影响因素

Analysis of Influencing Factors of Residents' Travel Mode Based on Decision Tree

Niu kai, Zhang Fuming, Chen Kuanmin
（Chang'an University）

Abstract:

As a basis for urban transportation planning and construction, residents' travel surveys are particularly important. The mining analysis of survey data can provide some reference for the improvement of traffic structure and the formulation of traffic policy. Based on the survey data of residents' travel in Xi'an in 2015, this paper analyzes the influencing factors of residents' travel. With the help of CART algorithm, the decision tree model under long-distance travel conditions and short-distance travel conditions is constructed. The research results show that under short-distance travel conditions, the purpose of travel is the main influencing factors of travel mode selection. On this basis, occupation, age, public bicycles, travel time have further influence on the choice of travel modes; long-distance travel conditions Under the age, the main influencing factors of travel mode, gender, occupation, whether there is a bus card, the willingness to buy a car, the purpose of travel will also have a certain impact on the choice of travel mode.

keywords: decision tree; CART; travel mode; influencing factors

作者简介：牛凯，长安大学，751158994@qq.com。

基于前景理论的出行行为研究综述

谭礼平
（重庆交通大学）

摘　要：出行者的出行行为对交通有巨大的影响，对出行行为的研究有利于改善交通拥堵。基于前景理论的出行行为主要研究出行者在不确定条件下的出行行为。本文先介绍了前景理论的基本思想，然后介绍了国内外基于前景理论的出行行为的研究现状，主要包括理论研究、出行路径选择、出行方式选择、路网均衡研究，并探讨了研究中的不足。前景理论还处于研究阶段，在出行路径选择、出行方式选择、路网均衡等方面都需要进一步研究。

关键词：前景理论；出行行为；路径选择；出行方式选择；路网均衡

A Review of Travel Behavior Based on Prospect Theory

Tan Liping
（Chongqing Jiaotong University）

Abstract:

The study of travel behavior which has a great impact on traffic is conducive to improving traffic congestion. The travel behavior based on prospect theory mainly studies travelers' behaviors under uncertain conditions. This paper firstly introduced the basic idea of prospect theory. Then the status of travel behavior based on prospect theory at home and abroad were illustrated, including theoretical research, travel route choice, travel mode choice, network equilibrium research, and the deficiencies in the research were discussed. The prospect theory is still in the research stage, and the travel route choice, travel mode choice and network equilibrium still need to further study.

keywords: prospect theory; travel behavior; route choice; travel mode choice; network equilibrium

作者简介：谭礼平，重庆交通大学，2791994074@qq.com。

国内大型机场车道边行人交通特征调查与分析

林子赫，王益，翁章斌，李琦
（北京工业大学 北京工业大学 北京城建设计发展集团股份有限公司 北京市市政工程设计研究总院）

摘　要：本文对国内五家大型机场进行了详细调研，从行人穿行速度、可接受间隙、等待时间以及管控措施等方面，对出发层车道边行人交通特性进行分析。研究结果表明：行人的年龄、结伴情况、行李数对穿行速度有显著性影响，性别对行人速度无显著性影响；行人在车道边人行横道的设计速度选取中年人的15%位速度适宜；行人等待时间与人行横道长度呈正相关；车道边人行横道间距的推荐值介于70m～75m；合理的管控措施可提高行人安全。工程设计人员可利用该研究的速度统计表与各车道边的现状设施设计数据，对车道边设施设计进行优化和改进。

关键词：交通管理；大型机场；出发层车道边；行人交通特性；接受间隙

Investigation and Analysis of Pedestrian Traffic Characteristics at Large Airports in China

Lin Zihe, Wang Yi, Weng Zhangbin, Li Qi
（Beijing University of Technology　Beijing University of Technology Beijing Urban Construction Design & Development Group Co., Limited 北京市市政工程设计研究总院）

Abstract:

This paper analyzed the pedestrian characteristics by conducting detailed investigations on Top 5 large airports in China, including pedestrian speed, acceptable gap, tolerable waiting time, control measures, etc. The results show that the age, partners and baggage of pedestrians have significant effects on the walking speed. Gender has no significant effect on the walking speed. 15% speed of middle-aged people is set the design speed of pedestrian at the airport curbside. The crosswalk width is positively correlated with the pedestrian waiting time. The recommended separation distance of crosswalk is between 70m and 75m. Reasonable control measures can improve pedestrian safety. Designers can use the speed statistics and the current facility design data at curbside to optimize and improve the curbside facility.

keywords: traffic management; large airports; departure curbside; pedestrian characteristics

作者简介：林子赫，北京工业大学，136067602@qq.com。

考虑步行和电动车影响的城市自行车出行选择行为分析

何婷婷，张生瑞
（长安大学）

摘　要：通过对大城市出行者的随机抽样调查，收集关于步行、电动摩托车、自行车出行的基础数据，分析出行者活动个体特征、出行特征、服务感知特征。运用到随机效用模型，以自行车作为参考方式建立方式选择 MNL 模型，并进行检验与拟合，以及参数估计分析。研究结果表明：（1）职业、出行时间和出行安全性对出行选择行为均具有显著性影响；（2）考虑的安全性越高，出行者选择步行出行的概率就越大，选择电动摩托车出行的概率就越小。相对于步行而言，电动摩托车与自行车之间的竞争较大，电动摩托车的速度快，三种出行方式中安全性最低，机动车影响也最大。

关键词：方式选择

Analysis of Urban Bicycle Travel Choice Behavior Considering the Impact of Walking and Electric Vehicles

He Tingting, Zhang Shengrui
（Chang'an University）

Abstract:

Through the random sample survey of travellers in big cities, the basic data about walking, electric motorcycles and bicycle trips are collected, and the individual characteristics, travel characteristics and service perception characteristics of traveller activities are analyzed. Apply to the random utility model, use the bicycle as a reference method to establish the MNL model, and test and fit, and parameter estimation analysis. The results show that: (1) occupation, travel time and travel safety have significant effects on travel choice behavior; (2) the higher the safety consideration, the greater the probability that travellers choose to walk, choose electric motorcycle The probability of travel is smaller. Compared with walking, the competition between electric motorcycles and bicycles is relatively large, and the speed of electric motorcycles is fast. The safety of the three modes of travel is the lowest, and the influence of motor vehicles is also the greatest.

keywords: mode selection

作者简介：何婷婷，长安大学，245299765@qq.com。

The Prediction Model and Algorithm for Passenger Flow of High-Speed Railway Based on the Sensitivity Factors Analyzing

Li Xiaojuan
Wang Junxia
Jian Meiying
Inner Mongolia University
311987431@imu.edu.cn

Abstract: Based on the condition before Beijing-Hohhot high-speed railway operation which is the first high-speed railway in north China, this paper proposes a method of stratified sampling to investigate the time-space travel behavior of existing railway passengers by designing the SP and RP questionnaires. By collecting SP data and RP data, Logistic regression analysis method was used for obtain the sensitivity factors for passengers who will choose high-speed railway. Based on the quantitative analysis of key sensitivity factors, the passenger flow prediction model and algorithm of passenger flow inducement after the Beijing-Hohhot high-speed railway operation are built. And the prediction method is made to provide theoretical support for the transportation organization, such as the train operation plan for the Beijing- Hohhot high-speed railway.

Key words: High-speed railway; passenger flow; prediction method; sensitivity inducing factors

旅游特色小镇出行特征及交通需求预测——以横店镇为例

韩竹斌，王海啸，毛海涛
（中咨城建设计有限公司南京分公司 中咨城建设计有限公司南京分公司 杭州市城市规划设计研究院）

摘　要：为构建旅游特色小镇交通需求预测模型，本文以横店镇 2018 年居民及游客出行调查数据为基础，分析归纳得出横店居民出行及游客出行的基本特征，总结分析二者出行特征的差异，并在此基础上研究提出旅游特色小镇的交通需求预测方法。最后将此交通需求预测方法应用于横店镇单轨交通线网规划客流预测项目。

关键词：特色小镇；出行特征；旅游客流；交通预测

Travel Characteristics and Traffic Demand Prediction of Tourism Featured Towns Take Hengdian Town as an Example

Han Zhubin, Wang Haixiao, Mao Haitao
（中咨城建设计有限公司南京分公司 中咨城建设计有限公司南京分公司　杭州市城市规划设计研究院）

Abstract:
In order to build a traffic demand forecasting model for small towns with tourism characteristics, based on the survey data of residents and tourists in Hengdian Town in 2018, this paper summarizes the basic characteristics of residents and tourists in Hengdian Town, summarizes and analyses the differences between the two travel characteristics, and puts forward a traffic demand forecasting method for small towns with tourism characteristics on this basis. Finally, the traffic demand forecasting method is applied to the passenger flow forecasting project of Hengdian monorail network planning.
keywords: Characteristic towns; travel characteristics; tourist flows; traffic forecasts

作者简介：韩竹斌，中咨城建设计有限公司南京分公司，799981502@qq.com。

西安城市发展与居民出行特征变迁分析

牛凯，田甜，余丽洁
（长安大学 长安大学公路学院）

摘　要：随着我国城市的快速发展，城市空间的扩张、人口在空间上的不均匀增长，使得居民出行特征发生很大的变化。本文通过对比西安市 2000 年、2008 年及 2015 年三次居民出行调查的相关数据，分析城市发展与居民出行特征变迁的关系。主要结论如下：在西安市发展过程中，GDP、人口等不断增长，但人口呈现中心区人口下降，边缘区域及外围新区上升的趋势，从而导致平均出行次数呈现中心区增加较少甚至减少、外围区域增长的情况；出行空间分布由单中心向多中心过渡，中心区聚集效应减弱。随着城市建设用地的不断完善，虽然居民出行各项指标均有所上升，但购物、休闲等娱乐活动出行距离有所下降。城市空间的不断扩大，导致午高峰消失，而小汽车出行比例快速上升。

关键词：居民出行；城市发展；出行特征变迁；西安

The Development of the City and the Changes of Resident Trip Characteristics in Xi'an

Niu kai, Tian TIan, Yu Lijie
（Chang'an University　Chang'an University）

Abstract:

Residents trip characteristics have been greatly changed because of the rapid development of the city, the expansion of the urban space, and the uneven growth of the population. By comparison of the person trip surveys in Xi’an in 2000, 2008, and 2015, this paper analyzes the relationship between the urban development and the changes of resident trip characteristics. Main results are as follows: With the development of Xi’an, GDP and the population have been increased, but the population decrease in the center and increase in marginal areas, so the trip frequency is little increase even decrease in the center and increase in marginal areas. The trip spatial distribution transforms from monocentric to polycentric, and the agglomeration effect of the city center is weakened. With the improve the urban construction land, almost all the indexes are increase, but the travel distance of shopping and relaxation is reduced. With the expansion of the urban space, the noon peak is disappeared, and the proportion of car trip increases rapidly.

keywords: resident trip; urban development; changes of resident trip characteristics; Xi’an

作者简介：牛凯，长安大学，751158994@qq. com。

Dynamic Life Course Analysis on Household Mobility Decisions

Guo Jia ,Feng Tao ,Zhang Junyi , Harry Timmermans
Eindhoven University of Technology (TU/e) Tu/e Hiroshima University Eindhoven University of Technology (TU/e)
j.guo@tue.nl

Abstract: Household members physically share various resources, such as their house, cars, etc. Consequently, models of mobility decisions ideally are models of household decision-making. To contribute to the further development of the relatively thin line of research on household decision-making in transportation studies, a dynamic Bayesian network approach is proposed to investigate the temporal interdependencies between various life course events within households. Results show that effects of child birth on residential change and car ownership change are much larger than the effects on job change for both members in dual-worker households. Moreover, the probability of residential change and car ownership change increases when both spouses have relatively long commuting time. Specifically, in case only husband faces excessive commuting time, the households have a larger probability of moving house or purchasing an additional car. In contrast, in case only wife faces excessive commuting time, she is more likely to change job rather than that the household takes an action to cope with the situation.

Key words: Life course; residential mobility; life course decisions; job change; household decision making; temporal dependencies

Simulation of Urban Passenger Taxi Services' Operation Based on Anylogic Model

Hu Xiaowei, Sun Yunrui , Alexey Morozov
Harbin Institute of Technology
xiaowei_hu@hit.edu.cn

Abstract: With the rapid development of communication technology and Internet technology, online taxi-hailing service has been gradually applied to the taxi passenger, especially in recent years. The purpose of this work is to study the most effective strategies to regulate the online taxi-hailing service and the traditional taxi service under the era of Internet +; and also to create a computer simulation model that will allow to change certain parameters, then to predict the functioning of the sphere of taxi in the future, as well as to analyse the research and preparation of recommendations for the transport development strategy of the city. The simulation model is formulated in the graphic language of the AnyLogic model. Simulation allows optimizing the system before its implementation. A basic model of the taxi market development was created. It reflects the nowadays passengers' distribution between the traditional taxi services and the internet taxi services and the dynamics of the growth of the taxi market in the city. The result of the experiments is analytical information about how the distribution of passengers is changing relative to the basic version of the taxi market development in Harbin.

Key words: passenger transportation, taxi service, operation strategy, Anylogic model, online taxi hailing service

Exploring the Influence of Family Structure and Built Environment on Household Car Ownership and Usage: A Bayesian Sample Selection Model

Wu Na ,Zhao Shengchuan ,Yao Ronghan
Chang'an University Dalian University of Technology Dalian University of Technology
wuna@chd.edu.cn

Abstract: In this study, we investigate household private car ownership and usage considering the dependence of the two decisions. A Bayesian sample selection model is formulated in the parametric framework to deal with the selection bias issue. Using the normal mixture approach, the model relaxes the bivariate normal assumption in the traditional sample selection model and can capture flexible coupling relationships, which is introduced by a Dirichlet prior. Moreover, the model does not require to specify the marginal distributions. After theoretical derivation, a simulation example is conducted to examine performance of the new model. To evaluate the robustness of estimation results, cross validation approach is employed. Three cross validation experiments using simulated data suggest that the new model is effective in revealing parameters' true values and in capturing actual error distribution. Considering overfitting issue, various tests are proposed and used to determine the most likely number of normal components. We then use the new model to study the influence of family structure and built environment on household private car ownership and usage. After testing, we find the new model with 3 components performs best in terms of goodness of fit and generalization ability. Compared with the new model, we find estimates from the traditional normal model are seriously biased regarding to magnitude, significance level, even the sign.

Key words: Car ownership and usage; Family structure; Built environment; Sample selection; Bayesian inference

Study on the Choice of Harbin Residents Travel for Work Based on Logit Model

Pei Yulong ,Ma Buzhen ,Wang Naihui
Northeast Forestry University
yulongp@263.net

Abstract: In order to explore the choice of working travel mode of urban residents, analyze the characteristics of different travel for working, divided urban passenger transport modes into public transport and private transport, and classified the influencing factors of working travel choice as internal and external aspects. Internal factors include individual attributes of travelers, travel attributes and family attributes of travelers. External factors include traffic policy and basis. Facilities and travel environment, etc. Logit multinomial regression model is introduced to study the choice probability of different travel modes. We choose Harbin as a significant city in the northeast of china to support our data processing. The results show that different travel attributes have great influence on the choice of residents travel for work. In this condition, the proportion of private traffic trip is larger than that of public transport trip.

Key words: Work trip

An Ordered Scobit Model with Heterogeneous Loss Attitude: A Study of Commuters' Bus Line Satisfaction

Zuo Zhi
Pan Xiaofeng
Xinjiang University
zuozhiukk@foxmail.com

Abstract: travelers might reveal heterogeneous loss attitude when evaluating transport policies. This paper aims to investigate heterogeneity of loss attitude by proposing an advanced order scobit model. A stated choice experiment about bus line satisfaction was taken as an example, in which respondents evaluated the current bus lines comparing ones before execution of a certain transport policy. Results confirmed the validity of the proposed model. Besides, we also found that 1) commuters' behavior revealed heterogeneous loss attitude; 2) although loss aversion was still dominated, attitude of "gain seeking" could also be found in some cases; 3) commuters' loss attitude was related to education level, income and marital status.

Key words: Ordered Choice; Loss Attitude; Heterogeneity; Scobit Model; Bus Line Satisfaction

Incorporating Multi-Level Taste Heterogeneity in Route Choice Modeling: From Disaggregated Behavior Analysis to Aggregated Network Loading

Li Dawei
Southeast University
lidawei@seu.edu.cn

Abstract: The aggregated traffic flow forecasting problem with multi-level mixed logit based route choice model is discussed in this paper. Multi-level unobserved taste heterogeneity in route choice is further divided to two parts, the OD pair specific and observation specific. With the proposed model, the observations between the same OD pair are correlated because of sharing the same OD pair specific taste heterogeneity. According to the theoretical analysis, these correlations result in the forecasting errors of aggregated link traffic flow that cannot be ignored as the increasing of number of trips. Numerical studies are carries out to illustrate the quantitative effects of incorporating multi-level taste heterogeneity on disaggregated route choice prediction and aggregated network loading, as well as the effects of model mis-specification on parameter recovery and prediction performance.

Key words: multi-level model, mixed logit, route choice, stochastic network loading

Which Time Variables Can Best Explain People Behavior on Mode Choice a Case Study of Xi'an, China

Xu Zhiman ,Wang Yuanqing
Chang'an University
xzm_andy@sina.com

Abstract: Travel time has always been an important factor in the study of travel behavior. It can be expressed by time-difference, time-ratio, etc. Through analyses different form of travel time in resident travel mode choice of workday peak period in Xi’ an urban area. We explore which time variables of whole travel have stronger interpretation of travel mode choice. Xi'an is a highly motorized metropolis with 8,831,100 permanent population and covers 10,096.81 km2. And the main motorized travel mode are car, bus and metro. Accordingly, MNL model and NL model are applied. The empirical analysis reveals that time difference is the most important time indictors in all for mode choice decision when controlling for the socioeconomic characteristics of travelers. And the result shows households with small population tend to choose car. By analyzing the marginal effects of variables in the optimal model, we find though people are most concerned about time when choosing a car, factors of occupation, car ownership and whether people have bus card have a more significant impact on car travelers. In conclusion, the results provide reference for the selection of time variables and formulate traffic policies according to travel characteristics to develop a better transit.

Key words: nested logit; public transport; travel behavior

公路网脆弱性评估方法研究

曹雅萍，刘箫
（长安大学）

摘　要：为应对突发事件对公路网的影响，促进我国公路网脆弱性的定量评估研究，本文通过对公路网中脆弱路段和节点进行分析和评价，研究了影响路网脆弱性的因素。建立层次化的分析方法将公路网脆弱性的评价因素划分为三个层面。分别从公路网的物理结构、公路网的运行情况和公路网对外部扰动的抵御性能上考虑，据此将公路网脆弱性划分为拓扑脆弱性、拥挤脆弱性和需求脆弱性。基于系统复杂网络理论评估其拓扑脆弱性，基于美国联邦公路局函数评估其拥挤脆弱性，基于需求曲线的计量经济评估方法评估其需求脆弱性，综合以上三种脆弱性建立公路网系统的整体脆弱性综合评估模型，并构建一套公路网脆弱度评估体系。

关键词：公路网；脆弱性；评估

Research on the Vulnerability Assessment Method of Highway Network

Cao Yaping , Liu Xiao
（Chang'an University）

Abstract:

In order to cope with the impact of emergencies on highway network and promote the quantitative evaluation of highway network vulnerability in China, this paper analysed and evaluates the vulnerable sections and nodes in highway network in order to find out the factors affecting the vulnerability of highway network. A hierarchical analysis method was established to divide the vulnerability assessment factors into three levels. The vulnerability of highway network was divided into three levels: topological vulnerability, congestion vulnerability and demand vulnerability based on the physical structure, operation and resistance to external disturbances. Topological vulnerability was assessed based on complex network theory, congestion vulnerability was assessed based on Federal Highway Administration function, and demand vulnerability was assessed by Econometric Assessment Method Based on demand curve. The overall vulnerability assessment model of highway network system was established by synthesizing three vulnerabilities, and a set of vulnerability assessment system of highway network was constructed.

keywords: highway network; vulnerability; assessment

作者简介：曹雅萍，长安大学，1755016178@qq. com。

多米诺骨牌算法及其在路径寻优中的应用

邵海鹏，闫东方，叶伟波
（长安大学；长安大学；龙游县交通运输局）

摘　要：为了在复杂的动态交通网络中更有效地寻找最短路及备选路径，本文基于多米诺骨牌效应原理设计了一种人工智能算法——多米诺骨牌算法。该算法借鉴骨牌依次不重复推倒相邻骨牌的特性，在时间维度上进行节点的正向标定和反向搜索判定来求解单源最短路。论文重点分析了多米诺骨牌算法在交通领域应用的特性，发现该算法适用于交通网络中任意起讫点间而非局限于节点间的最短路寻优，并具有定位实时性、普适性和全局性等特点。研究表明，在以城市道路为代表的稠密路网中，交叉口平均连接路段数稳定，路网总节点数大以及路段平均路权值小，多米诺骨牌算法的运算效率高于其他最短路算法，能在实际应用如实时导航中快速找到最短导航路径，适用性良好。

关键词：智能交通；人工智能算法；多米诺骨牌算法；路径寻优

Domino Algorithm and Application in Shortest Path Optimization

Shao Haipeng, Yan Dongfang, Ye Weibo
（Chang'an University;　Chang'an University; 龙游县交通运输局）

Abstract:

In order to find the shortest path and alternative path more effectively in the complex dynamic traffic network, this paper designs an artificial intelligence algorithm based on the principle of domino effect—domino algorithm. Referring to the feature that dominoes in sequence and does not repeatedly overrule adjacent dominoes, the algorithm performs forward calibration and reverse search on nodes in time dimension to solve the problem of shortest path from single source. This paper focuses on the analysis of the characteristics of domino algorithm in the field of traffic application, and finds that this algorithm is applicable to the optimization of the shortest path between any starting and ending points in the traffic network rather than between specific nodes, and has the characteristics of real-time positioning, universality and global. The results show that in dense road network represented by urban roads, the average number of connected links between the intersections is stable ,the total number of nodes in the road network is large, and the average road weight of sections is small, the computing efficiency of domino algorithm is higher than the other short path algorithm, which can quickly find the shortest path in practical applications such as a real-time navigation, and the applicability is good.

keywords: intelligent transportation; artificial intelligence algorithm; Domino algorithm; path optimization

作者简介：邵海鹏，长安大学，shaohp@chd. edu. cn。

大城市高快路网络生成方法研究

张宁，张小辉
（江苏省城市规划设计研究院）

摘　要：大城市发展扩张逐渐形成了具有一体化倾向的城市功能区域，由高速公路和城市快速路组成的高快路系统是满足城市长距离快速交通出行的主要载体。本文研究了高快路网络的生成方法，依托蜘蛛网交通分配方法，提出了城市快速路走廊判定技术；通过理论计算和城市案例，确定高快路环线半径的范围；应用基于节点重要度和路径随机搜索方法，生成虚拟高快路网络；匹配实际道路，得到高快路网络布局方案。

关键词：高速公路；快速路；网络生成

Research on the Network Generation Method of Highway and Expressway in Metropolitan Area

Zhang Ning, Zhang Xiaohui
（Jiangsu Institute of Urban Planning and Design）

Abstract:

Integrated urban functional areas generate with metropolis expanding, highway and expressway mainly meet the urban rapid travel of long-distances. The method of generating network about highway and expressway is focused in this paper. The urban Freeway Corridor determination technology is put forward, relying on spider web traffic assignment. The range of loop radius is researched through theoretical calculations and city case. The virtual network is generated based on importance of nodes and path random search method. The network layout scheme is obtained after matching the actual road network.

keywords: highway; expressway; network generation

作者简介：张宁，江苏省城市规划设计研究院，zhn210091@126.com。

基于吸引关系的停车场网络连接方法

冯树民，年东，赵琥
（哈尔滨工业大学）

摘　要：为研究停车场网络拓扑结构，提出了基于吸引关系的停车场网络连接方法。通过改进现有停车需求预测模型，充分考虑停车利用率、停车周转率、城市中心指数等因素影响，建立了新的停车场需求算法；通过绘制常规 Voronoi 图，利用断裂点理论的关键性质和常规 Voronoi 图的物理参数，划分各停车场的影响范围。引入吸引度概念，并对吸引度计算公式中的参数进行了修改和标定。计算停车场网络中每个节点的吸引度和节点间连线的边权，确定了停车场之间的连接情况。对哈尔滨市部分停车场进行吸引关系下的停车场网络模型构建。采用复杂网络参数分析方法对停车场网络进行分析，分别分析了规模赋值计算方法下和进一步通过吸引关系计算下的停车场宏观及微观节点参数。结果表明吸引关系下，停车场网络度分布符合幂律分布，无标度网络特征明显。与全局耦合网络和单边耦合网络对比，吸引关系下停车场网络具有较高聚类系数和全局有效性和较小的平均路径长度，在现有参数评价体系中表现均衡，是一种实用的停车场连接方式。

关键词：城市交通；复杂网络；吸引度；停车场；Voronoi 图；断裂点理论

Parking Network Connectivity Method Based on Attraction Relationship

Feng Shumin, Nian Dong, Zhao Hu
（Harbin Institute of Technology）

Abstract:

In order to research the topological structure of parking network, a new method of parking network connection based on attractive relationship is proposed. By improving the existing parking demand forecasting model and considering the factors such as parking utilization, parking turnover and urban center index, a new parking demand algorithm is established. Drawing a conventional Voronoi diagram and using the key properties of the fracture point theory and physical parameters of the conventional Voronoi diagram to divide the influence range of each parking lot, introducing the concept of attractiveness and modify and calibrate the parameters in the formula of attractiveness calculation. The degree of attraction of each node in the parking lot network and the edge weight of the connection between nodes were calculated. Then the connection situation between parking lots was determined. In this paper, the model of parking lot network is constructed under the attraction relationship of some parking lots in Harbin. The complex network parameter analysis method is adopted to analyze the parking lot network. The macro and micro node parameters of parking lot under the scale assignment calculation method and further calculation through the attraction relation are analyzed. The results show that the parking lot network degree distribution conforms to the power law distribution, and the scale-free network features are obvious. Compared with the global coupled network and the unilateral coupled network, the clustering coefficient and global effectiveness of the parking lot network under the attraction has a high relationship and a small average path length. This method is a practical mode which performance equilibrium in the existing

parameter evaluation system.

keywords: urban traffic; complex network; attractiveness; parking lot; Voronoi diagram; Break point theory

作者简介：冯树民，zlyfsm2000@sina.com。

Optimal Locations of En-Route Charging Stations for Electric Vehicles in Congested Transportation Networks

Zhao Yaobao , Chi Xie
Shanghai Jiao Tong University　Tongji University

Abstract: This research addresses a new electricity-charging station location problem for congested transportation networks, where electric vehicles with limited driving ranges need to be charged in the course of their trips. The goal of this location problem is to find, under a limited construction budget, an optimal set of charging station locations such that all vehicles can finish their trips by acquiring electricity from one or more charging stations along their routes and the total travel cost over the network is minimized. The problem is written into a bi-level nonlinear integer programming model, where the upper level of the problem is set to regulate the selection of station locations while the lower level is used to characterize the equilibrium flow pattern formed by electric vehicles that all take their own minimum cost paths with sufficient charging opportunities. We solved this problem by a branch and bound procedure and tested it with the Sioux Falls network, the results of which clearly illustrates the solution behaviors with different driving range limits.

Key words: electric vehicles; driving range; charging station location; traffic equilibrium

公路与城市道路平面交叉口差异协调设计研究

邓惠章，王树盛
（江苏省城市规划设计研究院）

摘　要：公路一般位于城市外围，主要服务于客货运机动车交通，而城市道路位于城市内部，交通参与者类型多，服务对象复杂，因此公路与城市道路的功能定位、横断面布置、路基路面结构、线形指标、排水系统等要素存在较大差异。对于公路与城市道路平面交叉口设计，主要考虑二者在功能定位、横断面布置、路基路面结构等三方面的差异。随着城镇化的推进，公路与城市道路平面交叉口在城市外围大量出现。现有研究对公路与城市道路差异、公路与城市道路衔接等方面论述较多，而对此类交叉口设计论述甚少。鉴于此，通过研究公路与城市道路的功能、横断面布置和路基路面结构等三个要素的差异性，结合仪征市高等级沿江公路和城市主干路万年南路交叉口改善设计实践，从要素差异协调的角度研究相关设计方案。设计方案提出，对于交叉口的进口道长度、右转弯专用车道宽度、安全停车视距、横断面布置等设计要素，公路与城市道路应区别对待，而作为城市道路客运与公路货运共用区域的路基路面，其结构设计标准应“就高不就低”，参考公路相关标准设计。

关键词：公路与城市道路交叉口；差异协调设计；功能定位；横断面布置；路基路面结构

Research on Difference Coordination Design of Highway and Urban Road Intersections at Grade

Deng Huizhang , Wang Shusheng
（Jiangsu Institute of Urban Planning and Design）

Abstract:

Highways are generally located in the periphery of the city, mainly serving for passenger and freight motor vehicle traffic, while urban roads are located in the city, with many types of traffic participants. Therefore, there are great differences in the function orientation, cross-section layout, subgrade and pavement structure, alignment index and drainage system between them. For the design of a highway and urban road intersection at grade, the main consideration is the difference of their function orientation, cross-section layout, subgrade and pavement structure. With the advancement of urbanization, a large number of such intersections appear in the periphery of the city. Existing studies have discussed the differences between highways and urban roads, and the connection between highways and urban roads, but seldom discussed the design of such intersections. In view of this, by researching on the differences of the functions, the layout of cross sections and the structure of subgrade and pavement, combined with the improvement design project of Wannian South Road and high-grade Yanjiang highway intersection of Yizheng City, the design scheme is studied from the perspective of difference coordination. The design scheme proposes that highways and urban roads should be treated differently for the design elements such as the length of the intersection approach, the width of the right-turn lane, the stopping sight distance and the layout of cross-section, while the roadbed and pavement, as the common area of urban roads' passenger transportation and highways' freight transportation, should be designed stringently

according to the relevant highway standards.

keywords: highway and urban road intersections at grade; difference coordination design; function orientation; cross-section layout; subgrade and pavement structure

作者简介：邓惠章，江苏省城市规划设计研究院，278539174@qq.com。

共享街道理念在历史街区中应用的思考——以天津市劝业场地区为例

魏星，高瑾
（天津市城市规划设计研究院）

摘　要：近年来，很多城市日益重视对历史街区的保护及更新利用，一部分历史街区在政府部门精细化管理下，通过建筑整修、业态调整、街道环境整治、市政设施改造等工作，逐步打造成为城市的旅游观光景区或商业区，并且成为了城市的名片。但也有一些地区由于历史风貌特点不突出、现状用地权属构成复杂、低收入居住人口比例较高等原因，地区发展及管理水平与其他地区有很大的差距，街道环境较差，同时机动车与非机动车共同利用狭窄的道路空间，使得交通安全环境得不到保障。比如位于天津市核心地区的劝业场地区就属于这样的地区。本文即试图通过对地区现状交通分析研究基础上，对于将共享街道理念用于类似地区交通规划进行尝试性的研究，目的是能够为此类地区提供确实有效的交通改善提升方案。

关键词：共享街道

Research on the Application of the Idea of Street Sharing in Historic Blocks-Take the Quanyechang Area of Tianjin as an Example

Wei Xing , Gao Jin
（Tianjin Urban Planning&Designing Institute）

Abstract:

Nowadays, the protection and reutilization of historic districts is becoming the focused issues. Under the fine management of government departments, Some historic districts have gradually become tourist attractions or commercial districts through building renovation, business adjustment, street environment renovation and municipal facilities renovation. But there are also some areas because of the lack of prominent historical features, the complexity of land ownership and the high proportion of low-income residents. There is a big gap between the development and management level of the area and other areas.In these areas,the environment of the streets stay in low quality.And the narrow road space is used by both motor vehicles and non-motor vehicles, which makes the traffic safety environment not guaranteed. For example, the Quanyechang area, located in the central area of Tianjin, is such a region. Based on the analysis of the current traffic situation in the region, this paper attempts to study on the application of the concept of shared street to traffic planning in similar areas, with the aim of providing effective traffic improvement and upgrading schemes for such areas.

keywords: shared sreet

作者简介：魏星，天津市城市规划设计研究院，5442747@qq. com。

城市道路多功能护栏

潘振建，董勤震
（临沂市费县公路管理局）

摘　要：城市道路通行的车辆、非机动车以及行人较多，为了保障道路安全，规范交通行为，广泛设置有道路护栏，以明确路面不同区域的功能，隔离不同形式的交通工具及行人，保障道路交通的规范有序及安全。目前常用的城市道路护栏在实践应用中，存在许多缺陷及安全隐患，为了进一步提升城市道路护栏的综合功能，更好的保护车辆及行人的安全，研发了城市道路多功能护栏，在满足原有护栏功能的基础上，提升其防撞性能，同时具备公路洒水降尘以及路面清洗的功能。

关键词：城市道路　多功能　护栏

Multifunctional Guardrail for Urban Road

Pan Zhenjian , Dong Qinzhen
（临沂市费县公路管理局）

Abstract:

There are more vehicles, non-motorized vehicles and pedestrians on urban roads. In order to ensure road safety and standardize traffic behavior, road guardrails are widely set up to clarify the functions of different areas of the road surface, isolate different forms of vehicles and pedestrians, and ensure the standardization, orderliness and safety of road traffic. In order to further enhance the comprehensive function of urban road guardrails and better protect the safety of vehicles and pedestrians, a multi-functional guardrail for urban roads has been developed. On the basis of satisfying the original function of guardrails, its anti-collision performance has been improved, and it also has the function of sprinkling water and dust on roads and cleaning pavement. Yes.

keywords: multi-functional guardrail for urban roads

作者简介：潘振建，临沂市费县公路管理局，lycandle@126.com。

上海市完整街道设计实践——以曹杨新村街区改造为例

崔诚靓
（上海市城市建设设计研究总院（集团）有限公司）

摘　要：上海市城市建设已经进入存量发展阶段，顺应时代发展需求，街道越来越注重精细化设计。2016 年《上海市街道设计导则》发布以后，上海在完整街道设计上进行了大量实践。本文在总结完整街道设计元素基础上，介绍了上海市曹杨新村街区改造的经验，对国内开展完整街道设计工作有一定指导意义。

关键词：完整街道；设计元素；街区改造；曹杨新村

Shanghai Complete Street Design Practice-Taking the Streets Reconstruction in Caoyang Xincun as an Example

Cui Chengliang
（Shanghai Urban Construction Design Research Institute (Group) Co., Ltd）

Abstract:
Shanghai's urban construction has entered the stage of stock development, and in response to the development needs of the times, the streets have increasingly focused on refined design. After the release of the “Shanghai Street Design Guidelines” in 2016, Shanghai has carried out a lot of practice in the design of complete streets. Based on the summary of the complete street design elements, this paper introduces the experience of street reconstruction in Caoyang Xincun Street, Shanghai, which has guiding significance for the development of complete street design in China.
keywords: complete street; design elements; block renovation; caoyang xincun

作者简介：崔诚靓，上海市城市建设设计研究总院（集团）有限公司，cuichengliang@sucdri.com。

基于 VISSIM 的城市道路交叉口掉头模式研究

邓雷，朱彤，罗珅
（长安大学 长安大学汽车学院）

摘　要：为评价城市道路交叉口三种典型掉头模式的安全性及通行效率，结合 Synchro、VISSIM 和 SSAM 仿真软件对其通行效率和安全进行了研究。结果表明：进口道上游掉头模式产生的交通冲突量最少，停止线前掉头模式下车辆的排队长度最小，采用进口道上游掉头模式既可以明显减少交通冲突的产生数量，也对交叉口车辆运行效率的影响较少，是三种掉头模式中的最优方案。

关键词：交通运输；城市道路；信号交叉口；掉头模式

Research on U-Turn Mode of Urban Road Intersection Based on VISSIM

Deng Lei , Zhu Tong , Luo Shen
（Chang'an University）

Abstract:

To evaluate the safety and traffic efficiency of different U-turn modes at urban road intersections, micro-traffic simulation methods are applied to establish a simulation model based on VISSIM to simulate vehicle U-turn behavior. Based on the trajectory data obtained from traffic simulation and the evaluation index of vehicle operating efficiency, three typical U-turn modes of urban roads were studied. The results show that the traffic collision caused by the U-turn upstream mode is the least. The queue length of the vehicle in the U-turn mode is the smallest. The upstream U-turn mode of the import road can significantly reduce the number of traffic conflicts and the efficiency of the intersection traffic. The impact is less and is the best of the three U-turn modes.

keywords: transportation; urban road; signalized intersection; u-turn mode

作者简介：邓雷，长安大学，ChdDengLei@163.com。

An Improved Traffic Organization Method for Multi-Road Intersections

Ma Qinglu , Wang Qi , Qiao Ya
Chongqing Jiaotong University
mql360@qq.com

Abstract : There are two effective methods to improve the traffic safety and operating efficiency of multi-leg intersection, which are signalized roundabout and signalized intersection. However, the fatal weakness of signalized roundabout is limited capacity for traffic and occupies excessive when traffic overloaded; the signalized intersection increased the stop delay. To compare with the practicability of two reforming approaches, a representative rebuilt example of the six-leg intersection is proposed based on parameter survey, such as road structure, traffic flow and traffic OD. The average traffic delay and queuing length are selected in the different traffic organization modes to evaluate the reconstruction effect. The simulation results show that the maximum delay would be reduced by 9.3 seconds, and the traffic capacity would be increased by 12%. Compared with signalized roundabout, the method of signalized intersection not only provides a good mirror for the reconstruction of multi-leg intersections, but also offers relevant theoretical and practical exploration.

Key words: multi-leg intersection; capacity; traffic delay; queuing length

高速公路长大下坡路段防眩板设置高度研究

顾文晨，张敏
（长安大学）

摘　要：为了解决高速公路长大下坡特殊路段存在的对向车辆眩光引起的交通安全问题，本文对防眩板设置高度计算模型进行分析，结合最不利车道组合形式以及动静视距差对交通安全影响分析，提出了防眩板设置高度优化方案，并给出设置高度检验流程。研究结果表明：防眩板设置的高度在实际运用中不会随着计算模型而连续变化，而是存在一个阈值，超过这个上下限会对道路安全造成一定的影响，设置高度不宜过高或过低，应该结合实际情况，针对某一路段制定出防眩板实际高度。

关键词：交通工程；长大下坡；防眩板高度；交通安全

Height Analysis of Anti-Dazzle Plate in Long-Steep Downgrade Sections of Expressway

Gu Wenchen , Zhang Min
（Chang'an University）

Abstract:

In order to solve the problem of traffic accidents caused by glare of vehicles on special sections of highway such as long-steep downgrade, In this paper, the height calculation model of anti-dazzle plate is analyzed, combined with the most unfavorable lane combination and movement stadia bad impact on traffic safety analysis, anti-dazzle plate set up highly optimized scheme was proposed, and set the height of inspection process is given. The analysis shows that in practical application, the height of anti-dazzle plate will not change continuously with the calculation model, but there is a threshold value, exceeding which will cause certain impact on road safety. The height should not be too high or too low, and the actual height of anti-dazzle plate should be developed for a certain section according to the actual situation.

keywords: traffic engineering; long-steep downgrade; anti-dazzle plate height; traffic safety

作者简介：顾文晨，长安大学，18861071226@163.com。

面向实施的城市快速路规划评估及优化方法研究

孙刚，王进坤
（江苏省城市规划设计研究院）

摘　要：本文通过梳理快速路规划评估研究现状，总结既有快速路规划评估存在的主要问题，并从规划和实施两个层面提出城市快速路规划评估框架体系，包括宏观路网布局、交通组织评估和微观深化方案评估。并以评估体系为依据，提出“环形+放射式”快速路结构典型路段和节点优化建议。最后，以江阴市为例，评估既有快速路规划研究和深化方案存在的问题，并提出相应的优化建议。

关键词：快速路；实施方案；规划评估；优化方法

Research on Urban Expressway Planning Evaluation and Optimization Method for Implementation

Sun Gang , Wang Jinkun
（Jiangsu Institute of Urban Planning and Design）

Abstract:

By combing the research on the urban expressway planning evaluation, this paper summarizes the existing main problems. and propose a new evaluation framework from planning level and implementation stage. The framework consists of evaluation on road network layout, traffic organization and the design. Based on the framework, the optimization suggestions for the “Ring & Radial” urban expressway are proposed. Finally, taking Jiangyin as a case , the existing research and design of the expressway planning are evaluated, and optimizations are suggested..

keywords: expressway; implementation; evaluation; optimization.

作者简介：孙刚，江苏省城市规划设计研究院，tongjisg1989@126.com。

Modeling Interstation Travel Speed of Hybrid Bus Rapid Transit Within a Bayesian Framework

Hu Jihua , Liang Jiaxian
Sun Yat-sen University 深圳交通研究中心
hujihua@mail.sysu.edu.cn

Abstract: Interstation travel speed is an important indicator of the running state of hybrid Bus Rapid Transit and passenger experience. Due to the influence of road traffic, traffic lights and other factors, the interstation travel speeds are often some kind of multi-peak and it is difficult to use a single distribution to model them. In this paper, a Gaussian mixture model charactizing the interstation travel speed of hybrid BRT under a Bayesian framework is established. The parameters of the model are inferred using the Reversible-Jump Markov Chain Monte Carlo approach (RJMCMC), including the number of model components and the weight, mean and variance of each component.

Then the model is applied to Guangzhou BRT, a kind of hybrid BRT. From the results, it can be observed that the model can very effectively describe the heterogeneous speed data among different inter-stations, and provide richer information usually not available from the traditional models, and the model also produces an excellent fit to each multimodal speed distribution curve of the inter-stations. The causes of different speed distribution can be identified through investigating the Internet map of GBRT, they are big road traffic and long traffic lights respectively, which always contribute to a main road crossing. So, the BRT lane should be elevated through the main road to decrease the complexity of the running state.

Key words: hybrid BRT

城市公共交通相依网络特征分析

郑天尧，张鹞鹏，罗玲，罗清玉，黄方贞，黄静
（深圳市综合交通设计研究院有限公司 吉林大学交通学院）

摘　要：随着公共交通线路条数增加、线网密度增长，城市公共交通呈现出巨复杂特征。现有研究集中于分析常规公交与轨道交通单独成网情况下的网络特征，较少考虑常规公交和轨道交通的交互特性。本文考虑了乘客站点间旅行时间和换乘步行时间等因素，利用 Space L 和 Space P 方法，基于相依网络理论，建立了城市公共交通相依地理网络和可达网络。借鉴复杂网络的特征分析方法，利用节点度、最短路径长度、最短出行耗时、聚类系数等表征参数，分析了城市公共交通相依网络的拓扑特征。最后，以长春市公共交通网络为研究对象，详细分析了长春市公共交通相依地理网络和可达网络的拓扑特征，同时对比分析了单一常规公交网络、轨道交通网络与相依网络特征的差异性。结果表明，长春市公共交通网络服从无标度特征。本研究可为城市公共交通的网络优化和设计提供参考。

关键词：城市公共交通；相依网络；复杂网络；常规公交；轨道交通

Analysis of Urban Public Transit Dependence Feature

Zheng Tianyao , Zhang Kunpeng , Luo Ling , Luo Qingyu , Huang Fangzhen , Huang Jing
（深圳市综合交通设计研究院有限公司 Transportation College, Jilin University ）

Abstract:

With increasing amount of public transit routes and transit network intensity, urban public transit network exhibits extremely complicated features. Existing researchers focus more on independent network characters of regular bus or railway transit, with less focus on the interchange between two networks. This paper introduces the dependence theory, which build up the urban public transit dependence geography network and accessibility network by using the methodology of Space L and Space P, considering the weights of transit vehicle travel time between stops and passenger walking time for transfer. Referring to the parameters of complex network, the topology features of the dependence networks is established by introducing the node degree, shortest distance, shortest travel time, clustering coefficient. City of Changchun is set as an example of dependence geography network and accessibility network. Meanwhile the comparison between single transit network and dependence network is conducted to show the city network is submissive to the scale-free network[1]. This study can provide reference for the optimization and design of urban public transportation networks.

keywords: urban public transportation, dependence network, complex network, regular bus, railway transit

作者简介：郑天尧，深圳市综合交通设计研究院有限公司，513545025@qq.com。

基于公交行程延误分析的 BRT 一体化走廊设计方案研究

张媛媛
（上海市交通港航发展研究中心）

摘　要：为了解决城市日益严重的交通拥堵问题，很多城市选择修建 BRT 公共交通走廊，提高公共交通分担率来缓解道路交通压力，所以提高公共交通走廊的运行效率至关重要。基于此，本文通过调查城市公交走廊上地面公交行程时间，通过多维度定性和定量分析公交行程延误，为 BRT 一体化走廊公交行程延误提出缩减策略，形成 BRT 一体化走廊设计方案工具箱。

关键词：公交优先；行程延误；BRT 一体化走廊；方案工具箱

Research on BRT Integrated Corridor Design Scheme Based on Bus Travel Delay Analysis

Zhang Yuanyuan
（上海市交通港航发展研究中心）

Abstract:

In order to solve the increasingly serious traffic congestion problem in cities, many cities choose to build BRT public transportation corridors and increase the public transportation sharing rate to alleviate road traffic pressure. Therefore, it is very important to improve the operational efficiency of public transportation corridors. Based on this, this paper investigates the bus travel time on the city bus corridor, analyzes the bus travel delay by multi-dimensional qualitative and quantitative analysis, proposes a mitigation strategy for the BRT integrated corridor bus travel delay, and forms a design scheme combination toolbox for BRT integrated corridor, which has a certain guidance for the design of BRT integrated corridor.

keywords: bus priority; travel delay; BRT integrated corridor; scheme tool box

作者简介：张媛媛，上海市交通港航发展研究中心，yedaflower@163.com。

Improved Map-Matching Method for Transit Trajectory Reconstruction Based on Transit GPS Data: Case Study in Edmonton, Canada

Ai Teng (China)
深圳市综合交通设计研究院有限公司
526394085@qq.com

Abstract: Map matching shows its excellence in terms of generating the vehicle trajectory on the digital map, which is the foundation of trajectory-based bus travel time prediction model. An understanding of reliable map-matching method is necessary for developing the accuracy of real-time prediction results. This thesis provides an improved map-matching method, which has better performance in finding single bus trajectory than Spatial-temporal matching method, a well-recognized map-matching method used in previous research. Link identification and path inference are two key components for this method. The field test is conducted on a main arterial in Edmonton, Canada from Legar transit center to Century Park transit center.

Key words: map-matching; link identification; path inference; single trajectory; spatial-temporal matching

基于问题线路筛选模型的公交线网优化研究——以苏州市为例

吕斌，姚诚，杨秀英，张鹤
（启迪设计集团股份有限公司 苏州市城市客运交通管理处）

摘　要：随着苏州市区轨道逐步成网，常规公交线网迫切需要优化调整，与轨道主动对接。为了甄别问题公交线路进而进行优化，本研究以公交四化为核心，建立问题线路筛选模型。根据问题线路筛选模型，对市区 370 余条公交线路进行打分，筛选出综合得分低的问题线路，作为年度线网优化对象。通过对问题线路的具体指标分析，提出问题线路改善方案。最后，建立以公交四化为核心的线网优化力度评价机制，对年度线网优化力度及效果进行评价。从而进一步推动公交线网优化工作，逐步促成与轨道形成“两网融合发展”。

关键词：公交四化；问题线路筛选模型；线网优化力度评价机制

Research on Bus Line Network Optimization Based on Problem Line Screening Model-Taking Suzhou City as an Example

Lv Bin , Yao Cheng , Yang Xiuying , Zhang He
（启迪设计集团股份有限公司 苏州市城市客运交通管理处）

Abstract:

With the gradual networking of the urban track in Suzhou, the conventional bus network urgently needs to be optimized and adjusted, and it is actively connected with the track. In order to identify the problem bus route and then optimize it, This study takes the bus four as the core and establishes a problem route screening model. According to the problem line screening model, more than 370 bus lines in urban areas were scored, and the problem lines with low comprehensive scores were selected to be the target of annual line network optimization. Through the analysis of the specific indicators of the problem line, the problem line improvement plan is proposed. In the end, we will establish a network optimization strength evaluation mechanism with bus four as the core, and evaluate the annual line network optimization efforts and effects. Thereby, the optimization of the bus network will be further promoted, and the development of the two networks will be gradually formed.

keywords: bus four; problem line screening model; line network optimization strength evaluation mechanism

作者简介：吕斌，启迪设计集团股份有限公司，916204697@qq. com。

合肥轨道交通 4 号线双岛四线站设计

宛超群

（安徽省交通规划设计研究总院股份有限公司）

摘　要：结合合肥 4 号线丰乐河路站设计过程介绍了平行双岛式车站设置的前提条件以及同台换乘车站的优缺点，从而引发自己对后续换乘车站设计中应该注意的事项。

关键词：平行双岛　4/6 拆分　交路　停车折返配线　同台换乘

Design of Shuangdao Line 4 Station on Hefei Rail Transit Line 4

宛超群

（Anhui Transport Consulting&Desing Institute Co.,LTD.）

Abstract:

Combining with the design process of Fengle River Road Station on Hefei Line 4, this paper introduces the preconditions for setting up parallel double-island station and the advantages and disadvantages of the same station, thus triggering matters needing attention in the design of subsequent transfer stations.

keywords: parallel double islands 4/6 split intersection parking return wiring interchange

作者简介：宛超群，安徽省交通规划设计研究总院股份有限公司，417908043@qq.com。

基于站点分类的地铁接驳环境优化研究——以西安地铁为例

王威，李跃
（长安大学）

摘　要：接驳环境作为地铁服务水平的重要指标很大程度影响着乘客接驳方式的选择，由于城市内地铁车站众多且每个车站功能类型、周边环境不尽相同，有必要对站点进行分类研究。本文通过 SPSS 平台对接驳环境进行聚类分析将西安市地铁车站分为 11 类，基于 SP 调查采用组合设计法获取居民对纬一街站接驳环境的评价，选用 MNL 模型分析出行者接驳方式选择的影响因素，使用 TransCAD 标定参数。最后得到各接驳环境下步行、自行车和公交车的效用函数并对纬一街站进行接驳环境优化设计。

关键词：地铁站；接驳环境；聚类分析；MNL 模型

Study on Optimization of Subway Connection Environment Based on Site Classification-Taking Xi'an Subway as an Example

Wang Wei , Li Yue
（Chang'an University）

Abstract:

The connection environment as an important indicator of the subway service level greatly affects the choice of connection mode. Due to the large number of subway stations in the city and each station has different functional types and surrounding environments,it is necessary to classify the stations. In this paper, the clustering analysis of the connection environment by SPSS platform divides the Xi'an subway station into eleven categories. Based on the SP survey, the combination design method is used to obtain the residents' evaluation for the connection environment of Weiyijie station. Using MNL model to analyze the influencing factors of the choice of traveler's connection method and TransCAD to verify parameters. Finally, this paper obtains the utility function of walking, bicycle and bus in each connection environment and optimizies the design of the connection environment for Weiyijie Station.

keywords: subway station; connection environment; cluster analysis; MNL model

作者简介：王威，长安大学，wangwe@chd. edu. cn。

基于电动公交车运行条件约束的线路更换实证研究

李颖，曾荣俊，刘雨晴，王玉焕，于壮
（北京清华同衡规划设计研究院有限公司 北京清华同衡规划设计研究院 深圳城市交通规划设计研究中心）

摘　要：在节能减排的发展目标与现实要求下，各大城市均开始将燃油公交车更换为电动公交车，然而由于车辆性能和运营组织等方面的差异，线路更换存在较大现实制约。本文通过对电动公交车运行的调研，梳理了影响电动公交车运行的各类因子，构建了一套适用于更换电动公交车可行性评估的指标体系，并根据实际运用中的问题与限制确定指标阈值，利用 IC 卡、GPS 数据对指标进行匹配计算，开展适宜更换电动公交车的线路筛选，最终完成更换电动公交车线路可行性与经济性的实证研究，在不影响公交服务水平的前提下提出辅助公交线路更换的技术方法。

关键词：大数据；电动公交车；指标；线网布局

Empirical Study on Restriction of Configuring Electric Bus

Li Ying ， Zeng Rongjun , Liu Yuqing , Wang Yuhuan , Yu Zhuang
（Beijing tsinghua tongheng urban planning and design institute　Beijing Tsinghua Tongheng Urban Palnning&Desing Institute 深圳城市交通规划设计研究中心）

Abstract:

The performance and operation mode of pure electric buses are quite different from those of traditional fuel vehicles. In the context of the input of electric buses in major cities, this paper took investigation of the operation of electric buses. An index system suitable for the feasibility of bus replacement was constructed. According to the problems and limitations in actual application, the study determined the threshold of every index. And applying smart bus card and GPS data to matching the index, which helping with selection of suitable electric bus replacement lines, and finally complete the empirical study of replacing the electric bus line. Auxiliary bus line replacement without affecting the level of bus service.

keywords: electric bus; big data; indicator; bus line optimization

作者简介：李颖，北京清华同衡规划设计研究院有限公司，cathylee1102@sina.com。

苏州工业园区微巴规划及实施研究

张鹤，杨秀英，吕斌，杨文凯，周洋
（启迪设计集团股份有限公司）

摘　要：随着苏州轨道交通网络的发展完善，常规公交存在转型发展的迫切需求。本文从苏州工业园区公交的基本情况出发，提出一种新型公交模式——微巴，然后介绍微巴功能定位及发展目标、微巴需求及规模预测，进而提出微巴规划方案及 2018 年的实施计划，最后总结微巴实施情况。

关键词：苏州工业园区、微巴、规划、实施

Research on Planning and Implementation of Microbus in Suzhou Industrial Park

Zhang He , Yang Xiuying , Lv Bin , Yang Wenkai , Zhou Yang
（启迪设计集团股份有限公司）

Abstract:

With the development and perfection of Suzhou rail transit network, there is an urgent need for the transformation and development of conventional public transport. Starting from the basic situation of public transport in Suzhou Industrial Park, this paper puts forward a new type of public transport mode, micro-bus. Then it introduces the function orientation and development target, demand and scale forecast of micro-bus, and then puts forward the planning plan of micro-bus and its implementation plan in 2018. Finally, it summarizes the implementation of micro-bus.

keywords: suzhou industrial park, microbus, planning, implementation

作者简介：张鹤，启迪设计集团股份有限公司，543451870@qq. com。

考虑换乘站点时间权重的公交时刻表优化

张姚，曹振宇，蒋阳升
（西南交通大学）

摘　要：随着城市不断扩张，不同公交线路间的有效换乘是提高城市公共交通系统运行效率、减少乘客换乘等待时间的重要环节。对国内外公交时刻表优化设计现状进行相关研究，基于改变和优化线路偏移值的思想，构建出了考虑换乘站点时间权重的最小化乘客换乘等待时间的优化设计模型，并利用遗传算法对算例中的公交时刻表进行优化。与现有模型比较分析，结果表明：所建立的优化模型能减少公交网络总换乘等待时间；换乘站点的时间权重越大，该站点的换乘等待时间就越小，与实际情况相符。通过算例分析，验证了模型的有效性。

关键词：交通工程；换乘等待时间；公交时刻表优化；遗传算法；站点时间权重

Optimization Model for Public Transport Timetable with the Time Weight of Transfer Station

Zhang Yao , Cao Zhenyu , Jiang Yangsheng
（Southwest Jiaotong University）

Abstract:

With the continuous expansion of cities, effective transfer between different bus lines is an important part of improving the operation efficiency of urban public transport system and reducing the waiting time for passenger transfer. This paper analyzes in detail the status of bus schedule optimization at home and abroad. Based on the idea of varying and optimizing the offset of the bus lines, an optimal design model for minimizing the passenger transfer waiting time considering the utility value of the transfer station is constructed, and a genetic algorithm is developed in this paper. Compared with the existing models, the results show that the optimization model established in this paper can reduce the total transfer waiting time of the public transport network, and the larger the time utility value of the transfer station is, the smaller the transfer waiting time of the station is, which is consistent with the actual situation. The validity of the model is verified by a case study.

keywords: traffic engineering; transfer waiting time; bus schedule optimization; a genetic algorithm; the time-weight of transfer station

作者简介：张姚，西南交通大学，1530496857@qq. com。

Comprehensive Analysis on the Robustness of Urban Road Networks

Wen-Long Shang (China)
北京工业大学
shangwenlong1987@126.com

Huibo Bi (China)
北京工业大学
huibobi@bjut.edu.cn

Yanyan Chen (China)
北京工业大学
cydan@bjut.edu.cn

Abstract: This paper comprehensively analyses the robustness of urban road networks through topological indices based on the complex network theory and operational indices based on traffic assignment theory: User Equilibrium (UE), System Optimum (SO), and Price of Anarchy (POA). Analysing topological indices may pin down the most important nodes for URNs from the perspective of connectivity, while more sophisticated operational indices (such as those introduced in this study) are helpful to examine the importance of nodes for URNs by taking into account link capacity, travel demand and drivers' behaviour. The previous way is calculated in a static way, which reduces the computation times and increase the efficiency for quick assessment of the robustness of URNs, while the latter is in a dynamic way, namely, calculating is based on removal of individual nodes, although this way is more likely to capture realistic meanings but consumes huge amount of time. The efforts made here try to find the relationship between topological and operational indices so as to assist the assessment of robustness of URNs to local disruptions. 6 urban road networks are used as network examples, and results show that different indices reflect robustness characteristics of urban road networks from different ways, and rank correlations between any two indices are poor although weighted betweenness centrality has better correlations with operational indices compared to other topological indices.

Key words: Robustness; traffic assignment; topological indices; operational indices; urban road networks。

干路环形交叉口的交通优化设计研究——以榆林市榆阳路-上郡路交叉口为例

刘雨，颜淋丽
（同济大学建筑设计研究院（集团）有限公司）

摘　要：通常干路交叉口需要满足较强的交通功能需求；而环形交叉口在通行能力等方面的存在一定的局限性，因此干路环形交叉口交通组织方式在一定程度上不能满足干路的交通需求。本文以榆林市榆阳路-上郡路环形交叉口为例，在现状分析的基础上，通过定量计算与VISSIM仿真对交叉口进行改造设计，以提升交叉口通行能力，保证行人过街的安全性，提升慢行品质。

关键词：环形交叉口；交叉口设计；VISSIM仿真

Research on Traffic Optimization Design of Round Road Intersections-Taking the Intersection of Yuyang-Shangjun Road in Yulin as an Example

Liu Yu , Yan Linli
（同济大学建筑设计研究院（集团）有限公司）

Abstract:

Generally speaking, the main road intersection needs to meet the strong traffic function, however, there are some limitations in the capacity of roundabout. Therefore, this type of organization has not been able to meet the traffic demand of the main road. This article takes the circular intersection of Yuyang Road and Shangjun Road in Yulin as an example. On the basis of the analysis of the status quo, the intersection design is improved by quantitative calculation and VISSIM simulation to improve the traffic capacity of the intersection, ensure the safety of pedestrians crossing the street, and improve the quality of slow movement.

keywords: roundabout; intersection design; VISSIM

作者简介：刘雨，同济大学建筑设计研究院（集团）有限公司，sophialiuyu@126.com。

Automatic Stochastic Parameter Estimation Method of Macroscopic Traffic Simulation Models

Li Yang , Zhang Chao Sheng , An Yi Sheng
Chang'an University

Abstract: The fundamental diagram plays an important role in macroscopic dynamic traffic modelling. Many calibration methods for different forms of the single-valued fundamental diagrams have been proposed since the seminal work of Greenshields. However, the large variations exist in the fundamental flow-density diagram from empirical studies. This study proposes an automatic stochastic parameter estimation method for the first order macroscopic traffic models by using the converted traffic data (flow and density) from cartesian coordinate system to polar coordinate system. According to the new relationship between theta and distance, the kernel density estimation is adopted to estimate the nominal and the interval of the fundamental diagram. Consequently, the empirical study is conducted based on the data collected from U.K. M25 motorway by Motorway Incident Detection and Automatic Signaling (MIDAS) system.

Key words: stochastic fundamental diagram; speed threshold; polar coordinate system; kernel density estimation; motorway incident detection and automatic signalling (MIDAS)

作者简介：李颖，长安大学，yingli@chd.edu.cn。

Freeway Ramp Controls: Capacity Enhancement and Disruption Probability Analysed by Gap-Acceptance and Queuing Models

Ning Wu (China)
Ruhr University Bochum
ning.wu@rub.de

Zong Tian (United States of America)
Department of Civil and Environmental Engineering University of Nevada, Reno, MS 0258, Reno, NV 89557
zongt@unr.edu

Abstract: Freeway ramp-metering control is one of the major freeway management techniques used worldwide to improve safety and operations. However, a ramp-metering control is effective only when freeway traffic volume reaches a certain threshold level. When freeway traffic is low, there will be enough gaps in the freeway flow to accommodate the ramp-inflow volume, even when ramp traffic enters the freeway in platoons. In practice, ramp-metering threshold values are typically determined based on empirical studies. Aim of this paper is to develop theoretical models based on gap-acceptance theory to determine ramp-metering threshold values. The models take into account the effect of platoon size in the entry-ramps resulted from various ramp controls, including random inflows from uncontrolled ramp, platooned inflows from an upstream signal control, and uniform inflows from a ramp-metering control. Volume-based ramp-metering threshold values are derived using the models under different ramp-control situations. The study results clearly indicate that significant disruptions on freeway operations exist due to large platooned inflows caused by an upstream traffic signal, compared to random or uniform inflows. The models can also be applied to provide quantitative assessments from the perspectives of freeway capacity and safety, indicating that ramp-metering control results in increased freeway capacity, reliability, and safety.

Key words: ramp-metering control; gap-acceptance; freeway operations

基于 VISSIM 仿真的高速公路混合收费站通行能力分析

沈海旭，张敏，顾文晨，刘旭，亓鑫
（长安大学）

摘　要：近年来，高速公路交通量的逐年增长，车辆的通行需求已经远远超过原有按预测交通量设置的收费站设计通行能力。改善收费站的通行能力与服务水平是解决收费站通行拥堵的关键措施，也是提高整个高速公路通行能力及通行效率的有效方法。因此，ETC(Electronic Toll Collection）与 MTC（Manual Toll Collection system）混合式收费站逐渐成为我国高速公路收费的主要形式。本文在对混合收费站通行能力理论研究的基础上，结合实测数据，对混合收费站的交通特性、车道选择特性及车辆速度分布特性进行了分析，利用 VISSIM 对高速公路收费站进行建模和仿真，分析混合收费站交通特性以及车辆到达特性等因素对收费站通行能力的影响。根据仿真结果可以的到以下结论：合理的 ETC 车道数设置可有效提高收费站通行能力，一般而言 ETC 收费通道数设置为路段车道数的 2-3 倍；对于混合收费站而言，一般 ETC 车流对 MTC 车辆通道的通行能力几乎没有影响，但 MTC 车流一般会对 ETC 通道的通行能力造成一定影响，尤其是对于两条相邻的通道影响最大，且 ETC 通道外置比 ETC 通道内置受到的影响更大。

关键词：交通工程；混合收费站；通行能力；Vissim 仿真

Traffic Capacity Analysis of Highway Mixed Toll Station Based on Vissim Simulation

Shen Haixu , Zhang Min , Gu Whenchen , Liu Xu , Qi Xin
（Chang'an University）

Abstract:

In recent years, the traffic volume of expressway has been increasing year by year, and the traffic demand of vehicles has far exceeded the designed traffic capacity of toll stations set according to the predicted traffic volume. Therefore, ETC (Electronic Toll Collection) and MTC (Manual Toll Collection system) Toll Collection stations have gradually become the main forms of Toll Collection on highways in China. Improving the capacity and service level of toll stations is a key measure to solve the congestion of toll stations, and also an effective method to improve the capacity and efficiency of the whole expressway. Based on hybrid toll station capacity, on the basis of theoretical study, combined with the experimental data, the traffic characteristics of mixed toll station, vehicle arrives characteristics are analyzed, using VISSIM to highway toll modeling and simulation, analysis of mixed toll station traffic characteristics and the characteristics of vehicle arrives on the influence of toll station capacity. According to the simulation results, the following conclusions can be drawn: reasonable ETC lane number setting can effectively improve the capacity of toll stations, and the greater the deviation of ETC lane number setting, the greater the impact on the overall capacity of toll stations; For mixed toll stations, generally ETC traffic flow has little influence on the capacity of MTC vehicle passageway, but MTC traffic flow generally has some influence on the capacity of ETC passageway, especially for two adjacent passageways, and the influence of ETC

passageway outside is greater than that of ETC passageway inside.

keywords: traffic engineering; mixed toll station; traffic capacity; vissim simulation

作者简介：沈海旭，长安大学，m15619070932@163.com。

混有智能网联车队的交通流基本图模型分析

常鑫，李海舰，荣建，黄珠妃，赵国强
（北京工业大学）

摘　要：针对智能网联车辆市场占有率逐步增长的过程中存在的传统车辆和具有车队规模限制的网联车队组成的混合交通流，考虑网联车辆在车队中的角色以及混合交通流车辆的空间分布特征，提出了能够反映混合交通流中不同类型车辆随机分布特性的数学解析表达；并考虑期望车头间距随速度动态变化的交通流特性，构建了混合交通流中不同类型车辆的跟驰模型。基于此，推导了混有智能网联车队的交通流基本图模型，并对模型参数的敏感性进行了分析。结果表明，随着智能网联车辆市场占有率（渗透率）逐步提升，道路交通流通行能力随之提升。然而，当渗透率低于 0.3 时，异质交通流通行能力提升效果并不显著；当渗透率大于 0.5 后，交通流通行能力将大幅提升。另外，随着智能网联车辆的普及程度越来越高，车队规模的限制对交通流通行能力的影响越来越明显，且车队规模越大，异质交通流通行能力提升越多。研究从理论层面推导的混有网联车队的异质交通流基本图模型，为未来智能网联车辆大规模应用前的交通管理政策及交通设施设计等提供科学的理论方法支撑。

关键词：交通工程；混合交通流；智能网联车队；市场占有率；基本图

Analysis on Fundamental Diagram Model for Mixed Traffic Flow with Connected Vehicle Platoons

Chang Xin , Li Haijian , Rong Jian , Huang Zhufei , Zhao Guoqiang
（Beijing University of Technology）

Abstract:

Focusing on the traffic flow randomly mixed with regular vehicles and connected vehicles and platoons, this paper proposes a mathematical analytical expression that can reflect the random distribution characteristics of different types of vehicles in mixed traffic flow. Considering the dynamic characteristics of desired headway changing with speed, the car-following model of different types of vehicles was established. Then, the fundamental diagram of mixed traffic flow with intelligent connected vehicle platoons was derived. Moreover, the sensitivity of parameters of market penetration rate of connected vehicles and the maximum platoon size were analyzed. The results show that the traffic capacity will be gradually improved with the increase of the market penetration rate p. However, the improvement of capacity is not significant when p is lower than 0.3 and significant when p is greater than 0.5. In addition, with the increasing popularity of intelligent connected vehicles, the impact of platoon size on traffic capacity is becoming more and more significant. Meanwhile, the larger the platoon size is, the greater the heterogeneous traffic capacity will be. The fundamental diagram model of heterogeneous traffic flow mixed with connected vehicle platoons is derived from the theoretical level, which provides scientific theoretical support for the large-scale pre-application management policy and facility design of intelligent connected vehicles in the future.

keywords: traffic engineering; mixed traffic flow; connected vehicle platoon; market penetration

rate; fundamental diagram

作者简介：常鑫，北京工业大学，邮箱：changxin@emails.bjut.edu.cn。

Prediction on the Range of After-Crash Congestion Diffusion Along the Trunk Road

Xin Huang (China)
长安大学
897764188@qq.com

Wang Jianjun (China)
长安大学公路学院
wjjun16@163.com

Li Kailun (China)
长安大学公路学院
1245202664@qq.com

Abstract: The urban trunk road often bears the function of traffic flow evacuation. If the accident occurs on the trunk road, it will have a great impact on the traffic flow operation in the upstream of the accident. Based on the traffic flow theory, and considering the factors such as reduction of traffic capacity, reduction of traffic capacity under saturated flow rate, vehicle lane change and signal intersection after a traffic accident, this paper builds the expansion speed model of the congestion point after accident, and gets the result of influence scope of the congestion point when congestion spreads along the trunk road. Afterwards, the model reliability is verified by using the accident scenario hypothesis method and VISSIM simulation method. Through the result of the error analysis, the calculation results of the model could accurately describe the expansion situation of the congestion point after a traffic accident along the trunk road. Furthermore, it could provide an effective basis for emergency management after a traffic accident and vehicle evacuation of the affected area.

Key words: traffic accident; urban trunk road; congestion; VISSIM; traffic flow theory

基于全路段分析的快速路交通量构成分析及评价方法探索

华文浩，彭佳，於昊，吴爱民，梁浩
（南京市城市与交通规划设计研究院股份有限公司）

摘　要：本文以南京市纬七路快速路高架为例，通过划分周边交通小区，分析各路段上的交通构成，进一步明确快速路的功能定位、交通特征等，可为城市快速路的拥堵问题提供解决思路。同时借鉴高速公路匝道交织区通行能力的计算方法，量化计算快速路各交织段的服务水平，能够较为直观地暴露出立交节点所存在的问题。

关键词：交通构成；服务水平；快速路

The Exploration of Volume Composition Analysis of Expressway Traffic and Evaluation Method Based on Whole Road Section

Hua Wenhao , Peng Jia , Yu Hao , Wu Aimin , Liang Hao
（Nanjing Institute Of City & Transport Planning Co..Itd）

Abstract:
The paper takes the Weiqi Expressway in Nanjing as an example， analysing the traffic composition of each road section and further clarifying the function orientation and traffic characteristics of expressways by dividing the zones. It can provide solutions to the congestion problems of urban expressway. At the same time, the level of service of each weaving section can be calculated quantitatively by referring to the calculation method of traffic capacity in the weaving section of freeway ramp, which can more intuitively expose the problems of interchange.
keywords: traffic composition; level of service; expressway

作者简介：华文浩，南京市城市与交通规划设计研究院股份有限公司，huawenhao2014@outlook.com。

倒计时信号交叉口处的驾驶员行为决策研究

尹雨洁，张敏
（长安大学）

摘　要：为了探究倒计时信号灯对交叉口交通安全的影响，本文从驾驶员心理角度出发，对驾驶员在交叉口处的决策过程进行了分析。综合可能影响驾驶员行为的因素，基于交叉口实测数据，运用 Logistic 模型分别建立了倒计时信号交叉口的行为决策模型，并且对影响行为决策的因素进了敏感性分析。结果表明:倒计时信号显示时间以及距离停车线 20m 处的点速度对驾驶员的行为决策存在着显著影响。且为提高交叉口交通安全应该把车辆距离停车线 20m 处的点速度控制在 10-18m/s 之间。

关键词：Logistic 模型；倒计时信号灯；驾驶决策。

Research on Driver Behavior Decision at Countdown Signal Intersection

Yin Yujie, Zhang Min
（Chang'an University）

Abstract:

In order to explore the influence of countdown lights on traffic safety at intersections, this paper analyzes the decision-making process of drivers at intersections from the perspective of drivers' psychology. Based on the measured data of the intersection, the behavioral decision model of the countdown signal intersection was established with the Logistic model based on the factors that may affect the driver's behavior, and the sensitivity analysis of the factors that may affect the behavior decision was carried out. The results show that the countdown signal display time and the point speed at 20m away from the stop line have significant influence on the driver's behavior decision. And in order to improve the traffic safety at the intersection, the point speed of the vehicle at 20m away from the stop line should be controlled between 10~18m/s..

keywords: logistic model; countdown signa; driving decision.

作者简介：尹雨洁，长安大学，2017221161@chd. edu. cn。

Research on Optimization of Phases at an Intersection with Asymmetric Traffic Flow

Chen Hepeng, Qin Huanmei

（Beijing University of Technology）

Abstract： Urban road intersections are the key nodes of urban traffic. The traditional phase symmetrically release causes the saturation between the two traffic flows in one phase to be unbalanced. The critical traffic flow with large volumess requires more green traffic light time, while the opposite traffic flow requires less. Short, the traffic volumess difference between the two causes a waste of space and time resources of the intersections. For the situation that a pair of traffic flow in one phase is asymmetric at the intersection, the paper solves the asymmetry traffic flow at the intersection by setting the asymmetric phase on the basis of the leading and lagging phase plan. Simulation by VISSIM shows that the traffic running efficiency of intersections is significantly improved in unit time. The article can provide a reference for the improvement of the intersection.

Key words： Asymmetric phase; Signal intersections; Phase optimization; Traffic flow time difference; VISSIM simulation.

作者简介：陈贺鹏，北京工业大学，邮箱：chen_hepeng@163.com。

基于拥堵源头追溯的快速路匝道控制

章程，杨晓光
（同济大学）

摘　要：匝道控制能有效应对快速路拥堵。过去由于数据获取的限制，不得不引入较强的模型假设以确定匝道流入率，如今丰富的交通数据可在一定程度上替代模型假设。本文利用线圈数据识别快速路主线动态瓶颈，并根据轨迹数据所记录的车辆移动信息，追溯拥堵源头，以此精确地控制匝道车辆流入。研究基于现实场景建立了仿真以测试控制效果，结果表明，在传统控制难以改进交通状态的情况下，本方法可缓解甚至消除部分区段的拥堵，占有率降低 9.7%，流量提升 4.9%，速度提高 8.0%，行程时间降低 11.0%。

关键词：快速路；匝道控制；瓶颈；轨迹数据；线圈数据

Ramp Metering Control Based on Traffic Congestion Source Tracing

Zhang Cheng , Yang Xiaoguang
（Tongji University）

Abstract:

Ramp metering is an effective measure to address freeway congestion. Traditional ramp metering control had to introduce strong model assumptions due to the data limitation. Nowadays, rich traffic data can replace model assumptions to some extent. This paper uses loop detector data to identify dynamic bottlenecks, traces congestion sources according to the vehicle movement information recorded by trajectory data, and then accurately controls on-ramp traffic flows. The research establishes simulation based on the real-world scenario to test the control effect. Results show that the method can alleviate or even eliminate the congestion in some sections while the traditional control can hardly improve the traffic state. Our approach reduces the occupancy rate by 9.7%, increases the traffic flow by 4.9%, increases the average speed by 8.0% and reduces the travel time by 11.0%.

keywords: expressway; ramp metering; bottleneck; trajectory data; loop detector data

作者简介：章程，同济大学，cheng. zhang@tongji. edu. cn。

信号交叉口周期优化模型对比分析

杨祥一，乔相荣，包贤珍
（深圳市综合交通设计研究院有限公司）

摘　要：传统的交通信号交叉口优化模型是以数学模型为主，然后用单一的算法对模型进行求解，这已经无法满足正常交通运行的实际需求。而本文首先针对 Webster 方法计算饱和度较高的交叉口时易产生较大误差的问题，建立了以延误和通行能力为目标的双指标周期优化模型。然后运用智能组合算法对双指标周期优化模型进行进一步的求解。最后通过 VISSIM 仿真软件对双指标周期优化后的模型参数进行效果验证。相对于通过数学模型优化过的信号周期，仿真验证的前后效果十分显著，优化之后的模型不仅减少了停车延误、增加了驾驶员对道路畅通度的满意程度，而且大大的提高了道路的通行能力。

关键词：交通信号，优化模型，Webster 方法，VISSIM

Contrastive Analysis of Signalized Intersection Period Optimization Model

Yang Xiangyi , Qiao Xiangrong , Bao Xianzhen
（深圳市综合交通设计研究院有限公司）

Abstract:

The traditional traffic signal intersection optimization model is based on the mathematical model, and then use a single algorithm to solve the model, which has been unable to meet the actual needs of normal traffic. In this paper, we first use the Webster method to calculate the problem of large error when the intersection is high, and establish the double-index periodic optimization model with the delay and the traffic capacity as the goal. Then the intelligent combination algorithm is used to solve the double-index periodic optimization model. Finally, the VISSIM simulation software is used to verify the model parameters of the double index cycle. Compared with the signal cycle optimized by the mathematical model, the simulation results are very significant. The optimized model not only reduces the parking delay, increases the driver's satisfaction with the road smoothness, but also greatly improves the road capacity.

keywords: traffic signals; optimization models; webster methods; VISSIM

作者简介：杨祥一，深圳市综合交通设计研究院有限公司，619537183@qq.com。

Using Historical Controller Operating Data to Design the Cycle Length and Splits for Signal Coordination

Aobo Wang
(University of Nevada, Reno)

Abstract: This paper presents a practical approach to conduct the cycle length and splits for signal coordination projects using historical controller operating data. Currently, to design the cycle length and splits relies on Webster's model which requires well-collected traffic counts. Considered that using Webster's model is relatively time-consuming and ineffective for signal coordination, we proposed the timing methods based on cycle time history, phase time history, and split termination logging to provide suggested cycle length and splits for signals that have not been coordinated, and to help practitioners adjust cycle length and splits for improving the existing coordination systems. A case study has been conducted by simulation and the results show that the proposed timing methods can achieve very similar performance as the Webster's model and help practitioners improve the existing coordination systems. The proposed approach can potentially be adopted to save the cost of signal coordination projects.

Key words: traffic signal control, cycle length, data log

作者简介：Aobo Wang，University of Nevada, Reno，aobowang@nevada.unr.edu。

城市带状老城区单向交通组织研究——以三亚市河西片区为例

黄繁辉
（三亚市公安局交通警察支队交通设施管理大队）

摘　要：本文在对单向交通组织特点进行总结的基础上，以三亚市河西片区为例，分析了老城区、带状路网条件下单向交通组织的可行性。并对区域交通现状进行分析，充分考虑片区主要交通流方向、道路渠化、交叉口信号控制、非机动车管理和公交优先，提出河西片区单向交通组织设计方案。为设计老城区、带状路网条件下新建与改建片区的单向交通组织提供了解决思路。

关键词：单向交通；老城区；带状路网；交通组织设计

Research on One-Way Traffic Organization in the Old Urban Zone - Taking Hexi District of Sanya City as an Example

Huang Fanhui
（三亚市公安局交通警察支队交通设施管理大队）

Abstract:

On the basis of summarizing the characteristics of one-way traffic organization, this paper takes Hexi District of Sanya City as an example to analyze the feasibility of one-way traffic organization under the conditions of old urban area and belt road network. The current situation of regional traffic is analyzed, and the main traffic flow direction, road channelization, intersection signal control, non-motor vehicle management and bus priority are fully considered. The design scheme of one-way traffic organization in Hexi District is put forward. It provides a solution for the design of one-way traffic organization of new and reconstructed areas under the condition of old urban area and strip road network.

keywords: one-way traffic; old urban area; belt road networ; traffic organization design

作者简介：黄繁辉，三亚市公安局交通警察支队交通设施管理大队，1098441962@qq. com。

车让行人影响下的右转车道通行能力分析

王建军，卢霄娟
（长安大学）

摘　要：“车让行人”政策的实施，表面上象征着一个城市文明水平的提高，但道路的通行能力大大降低，尤其在两相位信号交叉口没有右转专用相位，右转机动车时时受到行人过街的干扰，造成整个交叉口通行能力的下降，基于停车线法、可接受间隙理论、视频调查等进行定量对比分析西安市雁塔北路与建设西路交叉口。最后通过改变行人交通量的方法进 VISSIM 的仿真，用排队长度和停车次数作为评价指标，结果表明行人交通量对右转机动车的通行能力有显著影响，当行人交通量超过 1000 Ped/h 时，排队长度和停车次数增长趋势趋于平缓，其研究结果可为信号交叉口的改善提供相关思路，同时可为交叉口的改善提供理论基础。

关键词：交通管理；车让行人；可接受间隙理论；VISSIM 仿真

Analysis of the Right-Turn Lane Capacity Under the Influence of Pedestrians

Wang Jianjun , Lu Xiaojuan
（Chang'an University）

Abstract:

The implementation of the "vehicle-to-pedestrian" policy, on the surface, symbolizes the improvement of a city's civilization level, but the traffic capacity of the road is greatly reduced, especially at the intersection of two phase signals, which has no dedicated phase for right turn. The right turn of vehicles is always interfered by pedestrians crossing the street, resulting in the decline of the traffic capacity of the entire intersection. Based on the parking line method, acceptable gap theory, video survey, etc., a quantitative comparative analysis is made on the intersection of yanta north road and construction west road in xi 'an city. Finally, a simulation of VISSIM is carried out by changing the pedestrian traffic volume, using queue length and parking times as evaluation indexes. The results show that the traffic volume of pedestrian has a significant impact on the traffic capacity of right turning motor vehicles. When the traffic volume of pedestrian volume exceeds 1000 Ped/h, the growth trend of queuing length and stopping times tends to be flat. The research results can provide relevant ideas for the improvement of signal intersections and theoretical basis for the improvement of intersections.

keywords: traffic management; car to pedestrians; acceptable gap theory; VISSIM simulation analysis

作者简介：王建军，长安大学，wjjun16@163.com。

综合交通枢纽一体化发展评估与对策建议

杨鸣，陆化普，张永波
（清华大学；清华大学交通研究所）

摘　要：本文对综合交通枢纽一体化的内涵、关键影响要素、发展目标及趋势进行了深入分析，在此基础上建立了评价指标体系，提出了指标属性值和无量纲化值的计算方法。并采用“AHP-熵值法”确定了基于专家经验和评价对象所处阶段的指标综合权重值。兼顾科学性与实用性构建了综合指数评估模型，并进行了实证研究。依据评价结果对我国目前综合交通枢纽一体化发展水平、主要问题及突破方向进行了探讨。

关键词：交通运输规划与管理；综合交通枢纽一体化；评价指标；综合指数模型

Research on Evaluation and Counter Measures of the Integrated Transportation Hubs

Yang Ming , Lu Huapu , Zhang Yongbo
（Tsinghua University; 清华大学交通研究所）

Abstract:

This paper establishes an evaluation index system based on the in-depth analysis of the connotation, key influencing factors, development goals and trends of the integrated transportation hubs. The calculation method of the index attribute value as well as the dimensionless value is proposed. The "AHP-entropy method" is used to determine the comprehensive weight value of the indicators based on the experts’ experience and the stage of the evaluation objects. Under the principle of scientificity and practicability, a comprehensive evaluation model is established and an empirical study is carried out. According to the evaluation result, this paper does an analysis of the current status, main problems and key points of China's integrated transportation hubs.

keywords: transportation planning and management; transportation hub integration; evaluation index; comprehensive evaluation model

作者简介：杨鸣，清华大学，1293231336@qq. com。

公交优先视角下的港湾式公交停靠站交通仿真评价

马信辉，张汝华，韩子双
（山东大学）

摘　要：港湾式公交停靠站是目前城市公交停靠站台常用的布设形式，通常设置于未设置公交专用车道或一些交通量较大的道路。根据城市公共交通优先发展的战略要求，从减少公交延误与提升公交运行平稳性的角度出发，通过交通仿真软件 VISSIM 对公交运行中中所采用的港湾式公交停靠站与常规条件下直接式公交停靠站进行仿真评价与对比分析，论证港湾式公交停靠站是否真正适合公交优先发展战略的内在要求。

关键词：港湾式公交停靠站；直接式公交停靠站；公交优先；交通仿真

Traffic Simulation Evaluation of Harbor-Shaped Bus Stops Under the Perspective of Public Transport Priority

Ma Xinhui , Zhang Ruhua , Han Zishuang
（Shandong University）

Abstract:

The harbor-shaped bus stop is a commonly used layout form for the urban bus stop. It is usually set up in a bus lane or a road with a large traffic volume. According to the strategic requirements of the urban public transport priority development policy, from the perspective of reducing bus delays and improving the stability of bus operation, the traffic simulation software VISSIM is used to simulate the harbor-shaped bus stop and regular bus stop used in bus operation. Evaluate and analyze whether the harbor-shaped bus stop is really suitable for the strategic requirements of the bus priority development policy.

keywords: harbor-shaped bus stop; regular bus stop; bus priority; traffic simulation

作者简介：马信辉，山东大学，973466827@qq.com。

无车承运人的经济学探析

Zhang Gaiping，董娜
（交通运输部科学研究院）

摘　要：随着“互联网+交通物流”的深度融合发展，在交通领域出现了很多新兴业态，如无车承运人、网约车等，本文以货运领域的新业态——无车承运人为研究对象，基于时空经济学的基本理论深入研究无车承运人的作用机理，并对无车承运整合货运的供给端和需求端的时空经济特性进行深入探析，构建了无车承运人时空匹配的分析框架，并对标研究美国、日本等国家无车承运人的发展，在体制机制、税收政策、保险设计等方面提出相应的政策建议，为行业管理部门制定决策提供支撑。

关键词：无车承运人

A Spatiotemporal Analysis on Non-Truck Operating Common Carrier

Zhang Gaiping , Dong Na
（China Academy of Transportation Sciences）

Abstract:

In recent years, with the integration of “Internet+ Transportation Logistics” deeply developed, there have been many new types in the transportation field, such as non-truck operating common carrier, online car-hailing, etc. This paper takes the new form of transportation in the field of freight transportation as the research object—non-truck operating common carrier. Based on the basic theory of space-time economics, this paper thoroughly studies the mechanism of the non-truck operating common carrier. Also, it makes deep analysis of the space-time economic characteristics of the supply and demand sides of the integrated non-truck operating common carrier. Using the framework, this paper tests the business development of non-truck operating common carrier in countries such as the United States and Japan. Finally, combined with analysis of the case and the practice of the development of China's non-truck operating common carrier, this paper puts forward the corresponding policy recommendations, and provides support for industry management departments.

keywords: non-truck operating common carrier

作者简介：gaipingzhang，China Academy of Transportation Sciences，zhaip@163.com。

Analysis on Performance and Capital Structure of Enterprise in Transportation Sector of China

Bai Pengrui , Hao Guorui , Xu Haicheng , Liu Haiping
College of Management Science & Engineering, Shanxi University of Finance & Economics Bank of Zhangjiakou School of Economics and Management, Chang'an University School of Economics and Management, Chang'an University

Abstract: Operation performance is a major issue in transportation management systems which is focused by professionals of the transportation field recently because profitability has been reduced when the operating scale is expanded in transportation sector of China. In this study, the authors evaluate economic performance for four modes in transportation sector by analyzing multiple attribute decision making method UOWA and analyze the relationship between capital structure and profit of enterprise in transportation sector of China. Through analysis, the enterprise's profit is related closely to the capital structure in transportation sector. Furthermore, by factor analysis, the authors conclude that the correlation between profit and asset-liability ratio is negative while the correlation between profitability and the owner's equity ratio is positive.

Key words: transportation sector; capital structure of enterprise; performance of enterprise; UOWA

作者简介：白鹏锐，College of Management Science & Engineering, Shanxi University of Finance & Economics，109795583@qq.com。

基于改进模糊综合评价法的高速公路应急救援能力评估研究

肖丽，林志
（重庆交通大学）

摘　要：在高速公路应急事件应急救援发生的过程中，对应急救援能力进行评估也十分重要。本文采用改进的层次分析-最小二乘法和熵权法相结合，得到更客观指标权重的模糊综合评价法，构建应急救援能力评价模型。通过在广乐高速公路中的使用表明，本文提出的评价指标体系比较符合实际，评价模型实际操作性强，评价结论可以客观真实地体现高速公路紧急事件的应急救援能力。该模型可推广对高速公路应急救援能力评估的应用。

关键词：应急救援能力评价；层次分析-最小二乘法；熵权法；改进的模糊综合评价法

Evaluation of Emergency Rescue Capability of Expressway Based on Improved Fuzzy Comprehensive Evaluation Method

Xiao Li , Lin Zhi
（Chongqing Jiaotong University）

Abstract:

In the process of emergency rescue of Expressway emergency incident, it is also very important to evaluate the emergency rescue capability. In this paper, an improved hierarchical analysis, least squares method and entropy weight method are used to obtain a fuzzy comprehensive evaluation method with more objective index weights, and to construct an evaluation model of emergency rescue capability. Through the use of Kwong Lok Expressway, it is shown that the evaluation index system proposed in this paper is more in line with the reality, the evaluation model is effective in practice, and the evaluation conclusion can objectively and truly reflect the emergency rescue ability of expressway emergency. The model can greatly popularize the application of highway emergency rescue capability evaluation.

keywords: evaluation of emergency rescue capability; hierarchical analysis-least squares method; entropy law; improved fuzzy comprehensive evaluation method

作者简介：肖丽，重庆交通大学，1099532984@qq. com。

限速对高速公路特征速度的影响研究

杨杰，许金良
（长安大学 长安大学公路学院）

摘　要：为综合研究高速公路限速对 V85、V15、V50 等特征速度的影响规律，通过速度指导限速设置，为高速公路现存的限速不合理问题提供理论依据，本文以西康高速安康至西安段为试验路段，连续收集同一车流经过 80km/h、100km/h 以及 120km/h 限速下的速度数据，建立不同限速方案下，V85、V15、V50 等特征速度与 v/C 的关系图像，并建立相关关系模型。研究表明，不同限速方案下 V85、V15、V50 与 v/C 呈一元二次方程关系。在自由流下，车辆行驶受限速值影响较大，限速每提高 20km/h，V85、V50 均提高 20km/h 左右，V15 的提高幅度约为 10km/h；而在非自由流下，限速值不再是影响车辆行驶速度的主要因素。

关键词：高速公路；限速；V85；V15；V50；v/C

Research on the Influence of Speed Limit on the Characteristic Speed of Expressway

Yang Jie , Xu Jinliang
（Chang'an University）

Abstract:

In order to comprehensively study the influence of expressway speed limit on characteristic speeds such as V85, V15 and V50, the speed limit is set to provide a theoretical basis for the unreasonable speed limit problem of expressway. In this paper, the Xikang Expressway Ankang to Xi'an section is used as the test section, and the speed data of the same traffic flow after 80km/h, 100km/h and 120km/h speed limit are continuously collected. Establish a relationship model between V85, V15, V50 and v/C under different speed limit schemes, and establish correlation models. The research shows that V85, V15, V50 and v/C have a quadratic equation relationship under different speed limit schemes. Under free flow, the speed limit of vehicle travel has a great influence. For every 20km/h increase in speed limit, both V85 and V50 increase by about 20km/h, and the increase of V15 is about 10km/h. Under non-free flow, the speed limit value is no longer the main factor affecting the speed of the vehicle.

keywords: expressway; speed limit; V85; V15; V50; v/C

作者简介：杨杰，长安大学，1318791767@qq. com。

新建高速公路限速方案制定原则研究

白国华，许金良
（长安大学）

摘　要：高速公路限速值的确定对高速公路的通行质量有着重要影响，新建高速公路在道路条件、行车干扰、交通组成等方面有着自身的优势，为高速行车提供了条件。结合不同高速公路的自身特性选用相应的限速标准，能够有效的发挥高速公路的运输功能。在对比分析国内外限速标准制定方式的基础上，归纳总结新建公路设计速度、运行速度、期望速度与限制速度的关系，定性地提出新建高速公路限速方案的确定原则，并结合云南省宣曲高速公路对该原则的适用性进行了检验。结果表明，通过该原则修正过的限速方案，能够在保证安全的前提下，有效满足驾驶员驾驶期望、提高道路通行效率。

关键词：交通工程；新建高速公路；速度关系；限速方案；工程验证；运营管理

Study on the Principles of Speed Limitation Scheme for New Expressway

Bai Guohua , Xu Jinliang
（Chang'an University）

Abstract:

The determination of speed limit value of expressway has an important influence on the traffic quality of expressway, new expressways have their own advantages in road conditions, traffic interference and traffic composition, which provide conditions for high-speed driving. Combine the different speed characteristics of different expressways to select the corresponding speed limit standard, which can effectively exert the transportation function of the expressway. On the basis of comparative analysis of the formulation methods of speed limit standards at home and abroad, this paper summarizes the relationship between design speed, operation speed, expected speed and posted speed of newly built expressways, qualitatively puts forward the determination principle of speed limit scheme for newly built expressways, and tests the applicability of this principle in combination with Xuan'qu Expressway in Yunnan Province. The result shows that the speed limit scheme amended by this principle can effectively meet the driver's driving expectations and improve road traffic efficiency on the premise of ensuring safety.

keywords: traffic engineering; new expressway; speed relationship; speed limit scheme; engineering verification; operation management

作者简介：白国华，长安大学，bgh0203@126.com。

Game Analysis of Economic Benefits of Railway High and Medium Speed Trains

Ying LI (China)
长安大学
2320395989@qq.com

Haonan JIA (China)
Chang'an University
786757329@qq.com

Ke SHEN (China)
Chang'an University
1351468490@qq.com

Abstract: With the development of China's economy and the in-depth implementation of the railway reform by the State Railway Administration, China's railway trains generally adopt a high- and medium-speed mixed-race organization model. However, it is still not comprehensive enough to study the impact of different speed matching schemes on economic benefits. Starting from the level of urban development, this paper constructs a dynamic game theory model for both first-tier and non-first-tier cities. Research on where the State Railway Administration can increase the speed of the train can bring higher economic benefits. Analyze the dynamic game behavior between the State Railway Administration and the first- tier and non-first-tier cities, and apply the inverse induction method to obtain the sub-game refined Nash equilibrium of the process. In order to develop a speed matching solution that is more adaptable to the market and has higher comprehensive income for the future. At the same time, it provides a theoretical reference for the further growth of railway economic benefits.

Key words: railway traffic, complete information dynamic game, reverse induction, subgame refined nash equilibrium

Impact of Platoon Dispersion on Signal Coordination at Downgrade Arterial Segments

RUI YUE (United States of America)
University of Nevada, Reno
ryue@nevada.unr.edu

Guangchuan Yang (United States of America)
University of Wyoming
yanggc1986@gmail.com

Jianqing Wu (United States of America)
University of Nevada, Reno
jianqingwu2015@gmail.com

Dongmei Lin (United States of America)
DKS
lindongmei@gmail.com

Yichen Zheng (United States of America)
University of Nevada, Reno
realzyc8847@gmail.com

Zong Tian (United States of America)
University of Nevada, Reno
zongt@unr.edu

Abstract: Platoon dispersion theory has been widely used across the world today as a guide of some traffic devices or strategies implementation. However, the empirical perspective can be distinct from the theoretical perspective. Thus, the theory may not be applicable in some specific but frequent happened conditions, such as downgrade and short segment conditions. This paper aims to evaluate the difference between the theoretical calculation results and empirical results under the downgrade condition. To address this issue, the study was decomposed to two subsections: data collection and data evaluation. Robertson's model was employed to calculate theoretical results, and a case in Reno, NV was used to collect field results. The analysis indicated that the theoretical model is not capable of addressing the platoon changes under downgrade condition. The platoon was found still existed at the end of the test segment, which suggests signal coordination can still be considered under downgrade but a long-space condition.

Key words: downgrade arterial segments, platoon dispersion, signal coordination

以绩效为导向的成本规制研究——推进公交行业预算绩效管理一体化

王势华，朱文，夏和飞
（上海闻政管理咨询有限公司）

摘　要：随着我国城市化向纵深发展，城市交通日益成为制约其可持续发展的瓶颈问题。优先发展城市公共交通有利于缓解日益突出的道路交通拥堵、环境污染等问题，也是实现我国可持续发展、构建两型社会等重大战略的组成部分。公交补贴是实施公交优先政策的重要经济手段，其成效显著，促进公交行业快速发展，但是公交亏损日益扩大，财政部门压力越来越大，开展公交行业绩效管理，提升财政预算绩效，成为各地财政部门及预算主管部门关注的地方。本文对公交行业绩效管理现状和存在的问题进行介绍，并结合绩效管理理念分析公交行业绩效管理中的主要抓手，其中重点对目前较热的成本规制如何融合绩效理念进行说明，建议建立以绩效为导向的成本规制，并以此为主要抓手，推进公交行业预算绩效管理一体化，不断提升财政资金的使用效率。

关键词：预算绩效管理；成本规制

Research on Performance-Oriented Cost Regulation: Promoting the Integration of Budget Performance Management in Public Transport Industry

Wang Shihua , Zhu Wen , Xia Hefei
（上海闻政管理咨询有限公司）

Abstract:

With the rapid urbanisation in China, urban transportation has become the bottleneck, restricting its sustainable development. Giving priority to the development of urban public transportation is conducive to alleviating the prominent growing problems such as traffic congestion and environmental pollution. Additionally, there is a strong requirement for a major strategic component that can realize China's sustainable development and build a two-oriented society. The Public transport subsidy policy has been an important economic tool that has significantly promoted the rapid development of the public transportation industry. However, as the financial losses of the public transportation industry continue, the department of finance experiences high pressure and is forced to keep an eye on the performance management of the public transportation industry so as to improve the performance of the budget. This article has introduced the current status and problems of performance management in the public transportation industry, combined with the performance management concept and analyzed the main methods in the performance management of the public transportation industry focusing on how current cost regulations integrate performance concepts. Realize the integration of budget performance management in the public transportation industry by establishing performance-oriented cost regulation so as to continuously improve the efficiency of the financial funds.

keywords: cost regulation; budget performance management

作者简介：王势华，上海闻政管理咨询有限公司，shi95113@163.com。

城市快速路入口匝道控制算法研究综述

袁新新，马庆禄
（重庆交通大学）

摘　要：针对入口匝道不同的控制算法，分析各类算法的区别及特点，选择合理的匝道控制算法对于充分利用快速路通行能力，改善交通条件，显著预防其交通堵塞，协调快速路与关联道路的交通组织，提高道路的服务水平起着关键的作用。首先，对入口匝道控制的方法进行分类。其次，根据匝道的控制范围把入口匝道控制分为单点控制和协调控制。然后，按照两种控制方法分别从传统控制算法和智能控制算法入手，对不同的控制算法进行总结。最后结果表明：智能控制算法具有实用性能有效的缓解交通拥堵，虽然计算复杂及学习时间长，但适用于目前复杂的交通状况。

关键词：入口匝道控制；局部控制；协调控制；传统控制算法；智能控制算法

Overview of Urban Expressway Entrance Ramp Control Algorithms

Yuan Xinxin , Ma Qinglu
（Chongqing Jiaotong University）

Abstract:

Aiming at different control algorithms of on-ramp, this paper analyses the differences and characteristics of various algorithms, and chooses reasonable on-ramp control algorithm, which plays a key role in making full use of the capacity of expressway, improving traffic conditions, preventing traffic jams, coordinating the traffic organization of Expressway and related roads, and improving the service level of roads. Firstly, the methods of ramp control are classified. Secondly, according to the scope of ramp control, ramp control is divided into single-point control and coordinated control. Then, according to the two control methods, starting from the traditional control algorithm and intelligent control algorithm, different control algorithms are summarized. Finally, the results show that the intelligent control algorithm has practical performance and can effectively alleviate traffic congestion. Although the calculation is complex and the learning time is long, it is suitable for the current complex traffic conditions.

keywords: on-ramp control; local control; coordination control; traditional control algorithm; intelligent control algorithm

作者简介：袁新新，重庆交通大学，1690054489@qq. com。

基于 5.8G 自由流的高速公路设计构想

韩若峰，张志伟
（长安大学 青海省公路建设管理局）

摘　要：随着我国高速公路不断完善智慧化、人性化发展中的各项基础设施，对于提升总体设计水平的研究也得以不断突破，车辆路径二义性的问题随着联网收费和 5.8G 自由流技术的应用，得到了彻底解决，这也突破了路径未能识别引起的各种瓶颈。本文主要对 5.8G 自由流应用之后，如何改善高速公路部分设计进行研究，通过介绍新的设计构想，对路网的灵活设计，服务区的综合开发利用，与旅游运输产业的结合发展，建立公路智能信息系统，提升高速公路服务水平，实现可持续发展。

关键词：道路与铁道工程；5.8G；高速公路设计；路网；服务区

Design Conception of Highway Based on 5.8G Free Flow

Han Ruofeng , Zhang Zhiwei
（Chang'an University 青海省公路建设管理局）

Abstract:

As China's highway continue to improve the infrastructure of intelligent and humanized development, the research on improving the overall design level is being continuously broken, the problem of vehicle path ambiguity is solved with the application of network charging and 5.8G free flow technology, completely solved, this also broke through the various bottlenecks caused by the failure to identify the path. This paper mainly studies how to improve the design of highway after 5.8G free flow application, by introducing new design ideas, flexible design of road network, comprehensive development and utilization of service areas, and development of tourism and transportation industry, established roads intelligent information system, to improve the service level of highway and achieve sustainable development.

keywords: highway and railway engineering; 5.8G; highway design; road network; service area

作者简介：韩若峰，长安大学，605840402@qq.com。

基于 VISSIM 仿真的施工区非机动车道通行能力模型

郝璐；田佳雨，陈宽民
（长安大学）

摘　要：为得出施工区对非机动车道通行能力的计算模型，考虑到影响施工区非机动车道通行能力的因素主要有非机动车道宽度、施工区长度以及混合非机动车流中电动车的比例，讨论三者对施工区非机动车道通行能力的折减。应用数学与物理学公式，考虑电动车超车行为计算混合非机动车流条件下非机动车道的宽度，利用 Vissim 交通仿真软件对不同施工区长度和电动车比例下非机动车道通行能力进行仿真，对仿真结果进行回归分析。得出混合交通流条件下自行车道的宽度修正系数，施工区长度与电动车比例的综合修正系数。将模型应用于实例验证，结果表明该方法在计算施工区自行车道通行能力上具有一定的实用性。

关键词：VISSIM 仿真；回归模型；施工区；非机动车道；通行能力

Bicycle Lane Capacity Model in Construction Area Based on VISSIM Simulation

Hao Lu , Tian Jiayu , Chen Kuanmin
（Chang'an University）

Abstract:

In order to obtain a calculation model for the capacity of bicycle lanes in the construction area the factors affecting the non-motor vehicle lane capacity in the construction area mainly include the non-motor vehicle lane width, the length of the construction area and the proportion of electric vehicles in the mixed non-motor vehicle flow.Discuss the reduction of the three on the capacity of non-motor vehicle lanes in the construction area. Applying mathematics and physics formulas, consider the overtaking behavior of electric vehicles to calculate the width of bicycle lanes under mixed non-motorized flow conditions.The Vissim traffic simulation software was used to simulate the bicycle lane capacity under different construction area lengths and electric vehicle ratios, regression analysis was performed on the simulation results.. The comprehensive correction coefficient of the width correction coefficient of the bicycle lane, the length of the construction area and the proportion of the electric vehicle is obtained under the condition of mixed traffic flow. The model is applied to the example verification. The results show that the method has certain practicability in calculating the capacity of bicycle lanes in the construction area.

keywords: VISSIM simulation; regression model; construction area; bicycle lane; capacity

作者简介：郝璐，长安大学，936775660@qq.com。

Sensitivity Analysis and Selection of Check Index of Signal Intersection Simulation Model Based on VISSIM

Zhang Meng Da , Zhou Chen Jing , Zhang Tian Tian , Han Yan
北京市城市交通运行保障工程技术研究中心 北京工业大学 北京建筑大学土木与交通工程学院

Abstract: Selecting check index quantitatively is the core of the calibration of micro traffic simulation parameters at signal intersection. Five indexes in the node (intersection) module of VISSIM were selected as the check index set. Twelve simulation parameters in the core module were selected as the simulation parameters set. Optimal process of parameter calibration was proposed and model of the intersection of Huangcun west street and Xinghua street in Beijing was built in VISSIM to verify it. The sensitivity analysis between each check index and simulation parameter in their own set was conducted respectively. Sensitive parameter sets of different check indices were obtained and compared. The results show that different indexes have different size of set, and average vehicle delay’s is maximum, so it’s necessary to select index quantitatively. The results can provide references for scientific selection of the check indexes and improve the study efficiency of parameter calibration.

Key words: micro traffic simulation; signal intersection; check index; sensitivity analysis; VISSIM

作者简介：张孟达，北京市城市交通运行保障工程技术研究中心，北京工业大学，364044610@qq.com。

基于多源数据的快速路交通平行实验平台搭建

赖金涛，杨晓光
（同济大学）

摘　要：解决城市快速路拥堵、安全、污染等问题，需要准确再现、解析和评价其快速变化的交通状态，并针对性地采取可能的管理控制策略。为实现这一目的，需要充分挖掘多源、实时的海量交通数据，并建立与真实交通场景相对应的平行仿真系统。本文以上海南北高架快速路为例，介绍了交通平行实验平台搭建的基本框架与流程，实现了交通参数挖掘、仿真模型校准、仿真模型验证、控制方案评估等技术模块。利用该平行实验平台，可以快速还原快速路交通场景，实现对不同交通控制方案的实时评估。

关键词：微观交通仿真；仿真参数校准；交通数据挖掘；平行实验平台；控制方案评估

Construction of Parallel Experimental Platform for Traffic on Urban Expressway Based on Multi-Source Data

Lai Jintao , Yang Xiaoguang
（Tongji University）

Abstract:

To deal with the problems of congestion, safety and pollution relevant to urban expressway, it’s necessary to precisely reproduce, analyze and evaluate the changing states of traffic on urban expressway. To achieve this goal, we need to analyze the traffic through mining the multi-source, real-time and mass traffic data, and build up a parallel simulation system corresponding to the real traffic scene. Taking the North-South Elevated Road in Shanghai as an example, this paper introduces the basic framework and process of constructing the parallel experimental platform for traffic on expressway, and realizes the technical modules including traffic parameters mining, simulation model calibration, simulation model verification, control scheme evaluation and so on. Employing this parallel experimental platform, we can reproduce real-time traffic scenarios quickly and realize real-time evaluation of different traffic control schemes.

keywords: traffic data mining; microscopic traffic simulation; simulation parameters calibration; parallel experimental platform; traffic control scheme evaluation

作者简介：赖金涛，同济大学，jintao_lai@tongji.edu.cn。

考虑交通流压缩性的混合非机动车元胞自动机模型

徐亮，金盛
（浙江大学 浙江大学建筑工程学院）

摘　要：本文针对混合非机动车交通流建立了一种新的多值元胞自动机模型。通过考虑混合非机动车交通流的压缩性，引入了压缩概率 p_c，使模型可以对所有道路宽度进行直接仿真，而不需要将道路宽度近似处理。并通过采集实测数据与模型仿真结果进行比较，验证模型的有效性。结果表明本文提出的改进模型得到的仿真结果更加贴近实际情况，可以有效模拟混合非机动车交通流的运行状态。

关键词：传统自行车；电动自行车；元胞自动机；压缩性

Cellular Automata Model for Mixed Bicycle Traffic Flow Considering Traffic Flow Compressibility

Xu Liang , Jing Sheng
（Zhejiang University 浙江大学建筑工程学院）

Abstract:

An extended multi-value cellular automata model was proposed for mixed bicycle traffic flow. By considering traffic flow compressibility, the probability of compression p_c was introduced into the model, which allows the model to simulate any width directly. The simulated results were compared with field data collected from Hangzhou to validate the proposed model. The comparison results show that the improved model can mixed heterogeneous bicycle traffic flow better.

keywords: regular bicycle; electric bicycle; cellular automata model; compressibility

作者简介：徐亮，浙江大学，xuliangccea@zju.edu.cn。

Calibration of Microscopic Traffic Simulation Models Using Metaheuristic Algorithms

Wei Fan
The University of North Carolina at Charlotte

Abstract: This paper presents several metaheuristic algorithms to calibrate a microscopic traffic simulation model. The Genetic algorithm (GA), Tabu Search (TS), and a combination of the GA and TS (i.e., warmed GA and warmed TS) are implemented and compared. A set of traffic data collected from the I-5 Freeway, Los Angles, California, is used. Objective functions are defined to minimize the difference between simulated and field traffic data which are built based on the flow and speed. Several car-following parameters in VISSIM, which can significantly affect the simulation outputs, are selected to calibrate. A better match to the field measurements is reached with the GA, TS, and warmed GA and TS when comparing with that only using the default parameters in VISSIM. Overall, TS performs very well and can be used to calibrate parameters. Combining metaheuristic algorithms clearly performs better and therefore is highly recommended for calibrating microscopic traffic simulation models.

Key words: calibration; microscopic traffic simulation model; genetic algorithm; tabu search; warm start

作者简介：Wei Fan，The University of North Carolina at Charlotte，wfan7@uncc.edu。

十车道高速公路施工区上游过渡区的最优长度研究

刘旭，张敏
（长安大学公路学院）

摘　要：为了获得十车道高速公路施工区上游过渡区的最优长度设置方案，本文利用微观交通仿真软件 Vissim 建立十车道高速公路施工区的仿真模型，并选择对上游过渡区长度影响较大的交通量和大车率作为变量，以等效最小安全距离、平均延误时间、平均速度作为指标，对交通流状况进行评价，从而获得在 55 种交通条件下的上游过渡区的最优设置方案，给十车道高速公路施工区上游过渡区的设置提供参考。

关键词：高速公路施工区；上游过渡区；Vissim

Study on Optimal Length of Upstream Transition Zone in Construction Area of Ten-Lane Expressway

Liu Xu , Zhang Min
（Chang'an University）

Abstract:

In order to obtain the optimal length setting scheme for the upstream transition zone of the 10-lane expressway construction area, this paper uses the microscopic traffic simulation software Vissim to establish the simulation model of the 10-lane expressway construction area and select the traffic that has a greater influence on the length of the upstream transition zone. The quantity and the big car rate are used as variables, and the equivalent minimum safety distance, average delay time and average speed are used as indicators to evaluate the traffic flow conditions, so as to obtain the optimal setting scheme of the upstream transition zone under 55 traffic conditions. Provide reference for the setting of the upstream transition zone of the 10-lane expressway construction area.

keywords: expressway construction area; upstream transition area; Vissim

作者简介：刘旭，长安大学公路学院，2018321049@chd. deu. cn。

Short-Term Traffic State Prediction Based on Support Vector Machine

Jinjie Qiu (China)
长安大学
13299111675@163.com

Xiaoqing Liu (China)
长安大学
254727669@qq.com

Ruyue Liu (China)
长安大学
2322563774@qq.com

Abstract: In practice, it is easily to cause the phenomenon that planned optimal path not be consistent with the actual best path due to the change of the Road traffic conditions. Given this situation, it is very important to predict future changes in short-term traffic flow conditions. In this paper, a mathematical model was established on the short-term traffic flow prediction based on support vector regression machine, with the speeds of the predicted roads as well as its connected sections as the input set, the kernel function was selected to train the support vector regression machine. Then the trained vector regression machine was applied and the input parameters were used to predict the traffic speed of the next time period. Finally, the model was tested by real-time monitoring data of some sections of the Second Ring Road in Xi'an. The prediction results show that the model is effective.

key words: traffic engineering; short term traffic flow forecasting; machine learning; SVR (support vector regression)

基于车辆受阻延误的干线协调优化控制研究

张敏，尹雨洁
（长安大学公路学院）

摘　要：干线协调控制是缓解城市交通拥堵和减少车辆延误的重要方式。本文基于干线交叉口车辆行驶特性，建立车辆经过信号交叉口时产生的延误时间模型，同时结合数解法进行干线协调优化控制，使得车辆到达信号交叉口时尽量不遇见红灯或者少遇见红灯，从而降低车辆在交叉口产生的延误时间，提高干线系统的运行效率。最后，通过 VISSIM 仿真软件进行干线协调优化评价，结果显示通过对单个交叉口车辆受阻延误的优化控制，可以有效减少车辆在交叉口的延误时间和排队长度，增加车辆在交叉口的通行能力，从而使得车辆在干线协调控制系统上产生的延误时间最小。

关键词：车辆受阻延误；干线协调控制；信号交叉口；VISSIM

Research on Coordination and Optimal Control of Arterial Line Based on Vehicle Blocked Delay

Zhang Min , Yin Yujie
（Chang'an University）

Abstract:

Arterial line coordinated control is an important way to alleviate urban traffic congestion and reduce vehicle delays. Based on the driving characteristics of vehicles at trunk intersections, this paper establishes the delay model of vehicles passing through signalized intersections. At the same time, it combines the numerical method to coordinate and optimize the control of arterial lines, so that when vehicles arrive at signalized intersections, they do not encounter red lights as much as possible or rarely encounter red lights, so as to reduce the delay time of vehicles at intersections and improve the operation efficiency of arterial line system. Finally, arterial coordination optimization assessment through the VISSIM simulation software, the result shows that through vehicle blocked delay control for single intersection, can effectively reduce the traffic in the intersection delay time and queue length, increase the traffic capacity of vehicles in the intersection, so as to make the vehicles produced in the arterial coordination control system of the minimum delay time.

keywords: vehicle block; arterial line coordinated control; signalized intersections; vissim

作者简介：张敏，长安大学公路学院，2017221157@chd. edu. cn。

A Cumulative-Prospect-Theory-Based Bi-Modal Stochastic User Equilibrium Model Under Tradable Credit Scheme: Considering Endogenous Reference Points and Transaction Costs

Han Fei
Chang'an University

Abstract: This paper investigates the traffic equilibrium assignment problem in a stochastic bi-modal network under a given tradable credit scheme (TCS). To describe traveler's risk-taking behaviors under uncertainty, the cumulative prospect theory (CPT) is adopted, with endogenous reference points considered. Travelers are assumed to choose the path with the minimum perceived generalized path cost, which consists of time prospect value (PV) and monetary cost. Then the CPT-based stochastic user equilibrium (SUE) and market equilibrium (ME) conditions are proposed to describe the stationary state of the bi-modal network under a given TCS. At the stationary state, the reference points remain constant and are consistent with the SUE flow pattern and the corresponding travel time distributions. An equivalent variational inequality (VI) model embedding fixed point (FP) model is established for the network equilibrium conditions. Some theoretical analyses are further conducted for the existence and uniqueness of the equilibrium solution. Based on the model properties, a heuristic solution algorithm is developed. The algorithm contains two-level iterations, and the outer iteration is to find the ME credit price, while the inner iteration is to determine the corresponding SUE flow pattern. Numerical experiments are provided to validate the model and algorithm.

key words: tradable credit scheme; cumulative prospect theory; endogenous reference points; generalized path costs; variational inequality model; heuristic solution algorithm

作者简介：韩飞，长安大学汽车学院，hanfei@chd.edu.cn。

中国客运航线网络结构特性与抗毁性研究

杨新湜，王梓旭
（中国民航大学）

摘　要：通过复杂网络理论对全国航线网络进行研究，以度分布，聚类系数，平均路径长度，节点重要性指标等为依据，分析中国航线网络的基本性质，并分析这些性质在近年来的演化，进而得到航线网络的变化特点。另外在网络常用特性的基础上探讨网络结构的抗毁性，并将 Louvain 算法应用于中国航线网络结构地划分，发现中国航线网络结构呈现明显的地域性特征，以及个别机场在航线网络结构中划分的特殊性。

关键词：中国航线网络；网络结构；复杂网络理论；Louvain 算法

Research on Network Structure Characteristics and Invulnerability of China Passenger Routes

Yang Xinsheng , Wang Zixu
（Civil Aviation University of China）

Abstract:

We establish a Chinese airline network model where nodes and edges denote airports and direct flights. The basic nature of Chinese airline network and the evolution of these properties in recent years is analyzed with degree distribution, clustering coefficient, the average path length and the importance indicator of nodes, then the characteristics of airline network changes were obtained. In addition, the Louvain algorithm is applied to the division of Chinese airline network structure, and it is found that the airline network of China has obvious regional features and the specificity of the individual airports in the airline network structure.

keywords: chinese airline network; network structure; complex network theory; louvain algorithm

作者简介：杨新湜，中国民航大学，wangzxo8@163.com。

Analysing the Resilience of Road Network in Urban Areas Based on the Network Topology and Traffic Characteristics

Xu Jinjiang , Chen Kuanmin , Huang Hainan
Fujian Agriculture and Forestry University, School of Transportation and Civil Engineering
Chang'an University 福建农林大学交通与土木工程学院

Abstract: The ability of the road network to maintain normal traffic functions has a critical role in the traffic operation systems when the road network in city area is damaged locally by some natural disasters such as urban floods. In this paper, we refine the concept of road network resilience and propose the "resilience indicator of the road network" (RIRN). Moreover, we present an integrated method to estimate the resilience of road network considering the network topology and traffic characteristics. First, the characteristics of the topological structure of an urban road network are analysed, and the topological index is structured based on the node degree, the betweenness centrality and the closeness centrality from Complex Network Theory. Second, the traffic index is structured based on the traffic volume and the surplus saturation degree (SSD). Third, a method is proposed to calculate the RIRN according to integrate the topological index and the traffic index. The methodology is demonstrated with a real case study considering different topological and traffic condition. The results showed that the accuracy of the resilience of road network is improved by considering the effect of traffic resilience. The effects of traffic characteristics on road network resilience are highlighted in this work and the results regarding the level of the resilience of road network can provide important information for decision makers in urban road network planning, traffic management and urban flood location control.

keywords: resilience of road network; complex network theory; traffic characteristics; surplus saturation degree (SSD).

作者简介：徐锦强，福建农林大学，xujinqiang@fafu.edu.cn。

基于植物生长模拟与遗传算法的城乡客运枢纽选址研究

徐行方，李旭辉
（同济大学）

摘　要：加快构建城乡综合运输体系是当前阶段和今后一个时期中国交通运输发展的重点战略方向之一。城乡客运枢纽的合理布局是构建城乡综合运输体系的核心技术内容，直接关系到城乡综合运输效率的发挥。本论文从服务城乡一体化发展的角度出发，以城乡居民出行总时间最小为目标，以交通流量平衡、枢纽容量和规划枢纽个数为约束，构建了用于城乡区域客运枢纽选址的多目标决策模型。以往大多数算法在计算局部最优解过程中，仅考虑了局部最优解与需求点的引力作用，忽略与全局枢纽点最优解之间的斥力作用，可能导致不符合实际的情况产生。为解决这一问题，提出了基于植物生长算法和遗传算法的组合算法，通过建立模拟植物生长算法得到全局最优解，再将其与需求点结合构建遗传算法进行多目标求解，得到选址方案。

关键词：植物生长模拟，遗传算法，城乡客运枢纽选址

Site Selection of Integrated Urban-Rural Passenger Transport Hubs by Using Combined Approach of Plant Growth Simulation and Genetic Algorithm

Xu Xingfang , Li Xuhui
（Tongji University）

Abstract:

With urban expansion and rural development in China, planning and construction of efficient urban-rural transport hubs is essential for residents within and around urban-rural fringes (a.k.a. in-between cities) as well as the integration of urban and rural areas. The development and integration of transportation and land use planning in the urban and rural areas is also one of the key transport strategies of the Chinese government at present and years onwards. Whether there would be a reasonable distribution of such passenger transport hubs across a wider region will play a crucial role in ensuring the success of an integrated urban-rural transport system. Based on the integrated development of the total urban-rural region, the work presented in this paper develops a multi-objective decision-making model for site selection of an urban-rural transport hub. The model aims at minimizing the total travel time of the residents living within city center and those around outer suburbs, taking into account the planned total servicing capacity of the transport hubs, as well as transit traffic equilibrium. The global and the best local optimum solutions estimated by the model could provide foundations that support an informed decision making on the choosing of planned hub locations across an urban-rural fringe. In this regard, most of the existing optimization algorithms are highly likely to produce a set of optimum solutions that may usually result in geographical proximity of one hub to another. To tackle this issue, the authors formulate an algorithm, which combines the plant growth simulation and genetic algorithm. The proposed method and the algorithm was tested and validated with a case study of its application to a specific

urban and rural area selected from southwest China.

keywords: plant growth simulation algorithm, genetic algorithm; site selection of urban-rural passenger transport hubs

作者简介：徐行方，同济大学，13502774@qq.com。

Reliability Analysis of Travel Time of General Bus in Microscopic Interval - A Case Study of Bus Route 355 in Suzhou City

Jing GE (China)
苏州科技大学
1160710029@qq.com

Liyan Zhang (China)
苏州科技大学
379067846@qq.com

Jian Ma (China)
苏州科技大学
9764634@qq.com

Abstract: Today, traffic congestion has become a common phenomenon in major cities. Giving priority to the development of public transportation is one of the effective ways to solve traffic congestion. For travellers, bus runtime reliability is the most important factor they consider. Studying the reliability of the running time of the conventional bus in the microscopic interval helps to study the running state of the bus from the micro level.This paper firstly outlines the definition and evaluation index of bus running time reliability, and defines the definition and evaluation index of bus micro-running time reliability. The article then processed the survey data, through the data processing, using Minitab software to establish a regression model to study the influencing factors of the reliability of the 355 bus transit time.Finally, the article proposes measures to improve the reliability of bus operation time of Suzhou 355 Road.

Key words: general bus; microscopic interval; travel time reliability; evaluation; regression model

Robust Bandwidth Optimization for Bus Systems Under Dwell Time Uncertainty

Dai Guangyuan , Wang Hao
Jiangsu Institute of Urban Planning and Design Southeast university

Abstract: Bandwidth optimization approaches can be applied to improve the performance of bus systems. A significant proportion of bus travel time is contributed by the dwell time, which is the key factor in robust bandwidth optimization. To address issues associated with dwell time uncertainty, two robust bandwidth optimization approaches. First, a set of dwell time scenarios is introduced to represent the dwell time uncertainty. Then, a basic model designed for bus systems is developed based on MAXBAND. On this basis, a robust bandwidth optimization approach based on an enumeration method and a scenario-based robust bandwidth optimization approach are generated. All approaches are computed in C++ and LINGO 11. Finally, all timing plans generated from the basic model and the two robust optimization approaches are evaluated by Monte Carlo analysis and VISSIM simulations to verify the performance of the two robust bandwidth optimization approaches.

Key words: dwell time uncertainty; scenario-based; MAXBAND; bandwidth optimization

作者简介：戴光远，江苏省城市规划设计研究院，285980736@qq.com。

西安地铁 3 号线客流敏感性分析

王丽丽，柯辉
（长安大学）

摘　要：客流预测前提的改变对具体轨道线路的客流量产生较为敏感的影响。针对站点周边土地开发利用与轨道线路间换乘情况两方面，对西安昆明池遗址开发、全运会体育中心建设以及规划年地铁线路的开通情况等三大方面作具体研究。结果表明，昆明池遗址的开发将产生较大的游客运输作业；全运会体育中心的建成会带来突发客流及远期持续客流；规划年投入运营的轨道线路与 3 号线的换乘客流。根据研究结果对 3 号线客流规模作敏感性分析。

关键词：客流预测；客流量变化；敏感性分析

Sensitivity Analysis of Passenger Flow on Xi'an Subway Line 3

Wang Lili , Ke Hui
（Chang'an University）

Abstract:

The change in the premise of passenger flow forecast has a more sensitive impact on the passenger flow of specific track lines. In view of the development and utilization of land around the site and the transfer between the track lines, the three aspects of the development of the Kunming Chi Site in Xi'an, the construction of the sports center of the National Games and the opening of the planned annual subway line were studied. The results show that the development of Kunmingchi site will generate a large tourist transportation operation; the completion of the National Games Sports Center will bring sudden passenger flow and long-term continuous passenger flow; plan the annual operation of the track line and the passenger flow of Line 3. According to the research results, the sensitivity analysis of the passenger flow scale of Line 3 was made.

keywords: passenger flow forecast;　passenger flow change;　sensitivity analysis

作者简介：王丽丽，长安大学，497272471@qq. com。

基于利益相关者理论的杭州市共享单车管理对策研究

闫鹏飞，陆维特，朱国旺
（浙江理工大学）

摘　要：利益相关者理论在确定公共资源配置方面具有一定的优势。本文基于利益相关者理论，走访相关单位与咨询专家意见，确定杭州市共享单车的九个利益相关者；其次，采用米切尔评分法，邀请从事公共交通管理工作的专家，对这九个利益相关者进行打分，确定每个利益相关者的类型，建立权力/利益矩阵，找出主要的利益相关者。最后，分析主要利益相关者的诉求，从三个主要的利益性者角度，对杭州市共享单车的管理提出了对策。

关键词：利益相关者；米切尔评分法；权力/利益矩阵；管理对策

Research on Management Strategy of Shared Bicycle in Hangzhou City Based on Stakeholder Theory

Yan Pengfei , Lu Weite , Zhu Guowang
（Zhejiang Sci-Tech University）

Abstract:

Stakeholder Theory has certain advantages in determining the allocation of public resources. Based on stakeholder theory, this paper visits relevant units and consulting experts to identify nine stakeholders sharing bicycles in Hangzhou. Secondly, using Mitchell scoring method, experts engaged in public transport management are invited to grade the nine stakeholders, determine the types of each stakeholder, establish power/interest matrix, and identify the main stakeholders. Guan. Finally, this paper analyses the demands of the main stakeholders and puts forward some countermeasures for the management of shared bicycles in Hangzhou from the perspective of three main stakeholders.

keywords: stakeholders; mitchell scoring method; rights/interest matrix; management countermeasures

作者简介：闫鹏飞，浙江理工大学，469149680@qq.com。

基于 IC 卡刷卡间隔的上车人数计算

李强强
（长安大学）

摘　要：公共交通的地位日益增高，获取实时、全面的公交客流数据对城市公交的发展显得愈发重要。近年来，在现金支付及日渐普及的电子支付方式（如利用微信支付）乘车的背景下，IC 卡记录不能准确的记录乘客乘车信息。在相关论文研究的基础上，本文结合站点附近 POI，基于机器学习理论，考虑 IC 卡刷卡间隔内上车人数，提出公共交通上车人数的实时计算的方法，并根据实际调查数据验证了方法的可靠性，提高大数据的背景下公交运营单位的信息化服务程度。

关键词：IC 卡；刷卡间隔；机器学习；POI；Python

Calculation of the Number of People on Board Based on the Swipe IC Card Interval

Li Qiangqiang
（Chang'an University）

Abstract:

The status of public transportation is increasing. It is more and more important to obtain real-time and comprehensive bus passenger flow data for the development of urban public transportation. In recent years, in the context of cash payments and increasingly popular electronic payment methods (such as using WeChat payment), IC card records cannot accurately record passenger ride information. Based on the research of related papers, this paper combines the POI near the site, based on the machine learning theory, considers the number of passengers in the IC card swipe interval, proposes a real-time calculation method for the number of passengers on public transportation, and verifies the reliability of the method based on actual survey data., improving the information service level of bus operating units in the context of big data.

keywords: IC card; swipe interval; machine learning; POI; python

作者简介：李强强，长安大学，18788868586@163.com。

Evolutionary Mechanism of Competition and Cooperation Between Bus Lines Based on Passenger Volume

Zhang Daoyu , Meng Xianghai , Shao Yuan , Huang Qixiang
Shenzhen Urban Transport Planning Center　Harbin Institute of Technology

Abstract: Knowing the evolutionary mechanism of competition and cooperation between bus lines provides a strong theoretical support for the planning and optimization of bus lines. Based on the change of passenger volume, an evolutionary model of competition and cooperation between bus lines is presented. Through evolutionary analysis, the evolution diagram is obtained. From the evolutionary flow chart, we can see that: (a) when the attractiveness of two competitive lines is close and the passenger volume is large, the competition will continue. When optimizing, one of the lines needs to be adjusted to reduce the competition intensity. (b) When the attractiveness of the two competitive lines is close and the attraction volume of passengers is small, the two bus lines will gradually develop to a non-passenger state, which needs to be adjusted or optimized. (c) When the attractiveness of the two competing lines is different, the passengers of the less attractive bus line will flow to the more attractive bus line, resulting in less and less passengers on the less attractive bus line. At this time, the less attractive bus line should be changed. (d) When the attractiveness of the two cooperative lines is close, and the attraction of passenger volume is large, the cooperative state is stable. (e) The attractiveness of the two cooperative lines is no significant different, and the attraction of passenger volume is small. The cooperative state is morbid, so it is necessary to adjust the two bus lines in order to increase the attraction of passenger volume. (f) When the attractiveness of the two cooperative lines differs greatly, the passenger volume will gradually flow from the less attractive bus line to the more attractive bus line, forming an unhealthy cooperative state of "full" passenger volume on the more attractive bus line and insufficient passenger volume on the less attractive bus line. At this time, it is necessary to optimize and adjust the less attractive bus line.

Key words: passenger volume; competition; cooperation; evolutionary mechanism

作者简介：张道玉，深圳市城市交通规划设计研究中心，zhangdy@sutpc.com。

A Continuous Model of Bus Bunching That Considering the Queue Time at Bus Station

deng yjuan (China)
长安大学
yjdeng@chd.edu.cn

Cao Yaru (China)
长安大学
2017121154@chd.edu.cn

liu xiaohong (China)
长安大学
2017121138@chd.edu.cn

zhang dong (China)
长安大学
2017221156@chd.edu.cn

Abstract： Bus bunching is a common urban problem that caused by delays between stations ,at the stations or the intersections.In order to analyze the operation process of bus bunching, this paper construct the mechanism model of bus bunching based on velocity, passengers demand, the queue time at stations and space headway of buses. In terms of queue time at station, dividing the type of station into 6 forms according to the number of parking berth and the fact that whether the buses are allowed to overtake.Besides, the calculation process of the queue time of buses at different position in the queue for the different type of station is analyzed in detail. Through the simulation of queue time at different type of stations, it’ s found that the queue time of bus bay stop is large than linear bus stop’ s, and the queue time of bus station that not allows overtaking is large than the bus station that allows overtaking,and the futher back the bus in the queue, the longer it will queue up. Besides, 5 specific situation were set up. The mechanism model was simulated by Matlab, and the simulation data analyzed by Difference analysis method. It’ s concluded that the velocity and the queue time at station has the most significant influence on space headway, followed by loading efficiency and the arrival rate of passengers.

Key words： bus bunching

Dynamic Evolution Law and Prediction of Bus Bunching

deng yajuan (China)
长安大学
yjdeng@chd.edu.cn

LUO XIN (China)
长安大学
1961975160@qq.com

Abstract: This paper employed the bus GPS data, analyzed the evolution of the bus bunching phenomenon on the line. Headway were introduced to quantify micro bus operation condition. To consider the impact of predetermined interval on the analysis of bunching distribution on the whole line, an analysis method based on Headway Adherence Ratio (HAR) probability distribution is proposed. On the basics of division of bus operation condition, the dynamic evolution law of the bunching on the line is analyzed and the bus operation condition is predicted. Then, based on the knowledge of probability theory, the calculation model of bunching probability in different station and time period is derived. Five condition were classified at last, which are bunching, bunching transition, normal, large interval transition and large interval respectively. And for the dynamic evolution process of bunching, the results displayed that the property of probability, and bunching is a dynamic process of generation and dissipation. Finally, the established Multiple Logistic predicting model shows a good predictability for the prediction of bus bunching. According to the bunching distribution law analysis, from a spatial point of view, the bunching phenomenon is significant from station to station; from the perspective of time, the probability of bunching during peak hours is greater than the base period.

Key words: public transport; bus bunching; distribution law; bus operation condition evolution

一种考虑充电调度策略的纯电动公交车辆排班方法

程春阳，左兴权
（北京邮电大学）

摘　要：电动公交车辆排班问题是指给定公交线路发车时刻表，针对电动公交车辆的特性确定每台车辆的发车时间，以覆盖发车时刻表中所有发车时刻点，从而保证公共交通的服务质量。本文提出了一种基于模拟退火算法的电动公交车辆排班方法。该方法在车辆排班过程中考虑了电动公交车辆的续驶里程约束和充电资源约束，设计了电车充电调度策略，并将其集成到车辆排班过程中，以提高车辆和充电资源的利用率。利用实际公交运营数据验证了本文方法的有效性。

关键词：电动公交车辆排班；模拟退火算法；充电调度

An Electric Bus Vehicle Scheduling Approach Considering the Charging Strategies

Cheng Chunyang , Zuo Xingquan
（北京邮电大学）

Abstract:

The electric bus vehicle scheduling problem means that given the departure timetable of a bus line, determine the departure time of each electric bus aiming at the characteristics of electric vehicles, to cover all departure times in the timetable so as to ensure the quality of service. In this paper, we propose a simulated annealing algorithm based electric bus vehicle scheduling approach. In this approach, we consider the constraints of electric vehicles' driving range and charging resources, devise the scheduling strategies for vehicles charging, and integrate the strategies into the vehicle scheduling procedure to improve the utilization of vehicles and charging resources. Finally, the effectiveness of the proposed approach is verified using the actual bus operation data.

keywords: electric bus vehicle scheduling; simulated annealing algorithm; charging scheduling

作者简介：程春阳，北京邮电大学，chengchunyang@bupt.edu.cn。

Research on Real-Time Speed Control Method for Bus Bunching

Liu Xiaohong , Deng Yajuan , Zhang Min , Cao Yaru
Chang'an University

Abstract: It has become a common phenomenon for buses operating on high frequency public transport lines to arrive at stops in bunches,which will lead to a series of instability problems.Based on Advanced Public Transportation System,this paper studies the vehicle dynamic control problem of singular bus line to mitigate bunching.Using bus headway variations as the objective function,a real-time speed control model is proposed to improve not only headway adherence but also maintain a relatively high operation speed.Considering heterogeneous situations on different road sections,the model gives the corresponding range of speed adjustment according to the different congestion degree of each road section.The behaviour and performance of proposed model is validated with a case study based on data collected from NO.600 bus route with about 42 arbitrary spaced bus stops in Xi’an, China.The results show that the proposed model performs well on high-frequency bus route,the control method can restrain the amplification tendency of the headway deviation and reduce the travel time cost of the passengers.To a certain extent, it is conducive to maintain the order of the fleet and improving the service reliability of the fleet along the route.

Key words: public transport; bus bunching; real-time speed control; headway variation

作者简介：刘小红，长安大学，2017121138@chd. edu. cn。

En-Route Bus Reliability Evaluation with Real-Time Data at Network Scale

Hui Jin (China)
同济大学
jinhui_traffic@tongji.edu.cn

Yang Xiao Guang (China)
同济大学
yangxg@tongji.edu.cn

Yang Ze Lin (China)
同济大学
1731335@tongji.edu.cn

Abstract: Bus reliability has long attracted attention and been extensively studied to enhance service quality. However, existing research generally evaluates bus reliability of specific routes or stops. To this end, this study explores en-route bus reliability with real-time data at network scale. Drawing on data of bus automatic vehicle location and smart card in Ningbo, China, headway-based reliability is calculated with the difference between actual and scheduled headway at each stop, which is then weighted with passenger boarding volume. To demonstrate the trend of stop-level reliability along a bus route, reliability is graded and visualized on map with ridership at each stop. Then route-level reliability is quantified and mapped, where unreliable service basically concentrates in or extend through the center area. With respect to network-level reliability, temporal changes are demonstrated with ridership on weekday and on the weekend. It is observed that, on weekdays reliability trend is similar to that of ridership, implying the causal relationship between bus travel time variation and bus dwell time at stops. Further, comparison between weekdays in December and October shows the necessity of reliability evaluation periodically and around important events to avoid awful riding experience that discourages transit usage. This research provides insights for bus agencies to systematically evaluate service reliability both spatially and temporarily, in order to identify and prioritize the routes and stops where the scope for reliability improvement and the expected benefit are greatest, and so as to efficiently enhance transit service quality.

Key words: bus reliability evaluation; real-time data; network scale; multi-level evaluation; visualization

多支付形式下公交乘客上车能力影响分析

田甜，李培坤，马超群，朱才华
（长安大学）

摘　要：移动支付作为互联网经济快速发展的产物，已在公交车支付形式中成为主流行为；公交刷卡机作为公交车付费区与未付费区的节点，其上车通过能力的大小对公交站客流的疏运起着关键性作用，对晚高峰不同公交车站上车客流进行视屏录像，采用慢速回放观察记录，统计乘客属性、刷卡机属性、乘客连续刷码、刷卡及投币乘客通过刷卡机的时间及各类付费方式的比例，采用 SPSS 统计分析软件进行数据分析，计算乘客通过刷卡机速度并分析刷卡机通过能力影响因素。

关键词：公交支付形式；上车延误；影响分析

Analysis of the Influence of Bus Passengers' Ability to Enter the Car in the Form of Multi-Payment

Tian Tian , Li Peikun , Ma Chaoqun , Zhu Caihua
（Chang'an University）

Abstract:

As a product of the rapid development of the Internet economy, mobile payment has become the mainstream behavior in the form of bus payment; the bus credit card machine serves as the node of the bus pay zone and the unpaid zone, and the traffic passing capacity of the bus stops the passenger flow of the bus stop. It plays a key role in video recording of passengers on different bus stations at night peaks, using slow playback observation records, counting passenger attributes, credit card machine attributes, continuous brushing of passengers, card swiping and time spent by coin-operated passengers through credit card machines. And the proportion of various payment methods, using SPSS statistical analysis software for data analysis, calculate the speed of passengers through the credit card machine and analyze the factors affecting the ability of the credit card machine.

keywords: bus payment form; boarding delay; impact analysis

作者简介：田甜，长安大学，343554061@qq.com。

Managing Transportating Infrastructure in Nigerian Cities

NNAEMEKA EMMANUEL ABAH (Nigeria)
Directorate of Traffic Service Abuja
nnaemekaabah@gmail.com

Abstract: This paper evaluates the management of urban transportation infrastructure in Nigeria. It does so by defining transport infrastructure to include both the locative and distributional role of transport. The argument is general because transportation is similar in most cities, except in Lagos and Abuja with greater coordination and control. Nigeria's urban transportation is driven by the private sector, and should be regulated, but it is not. There is confusion in its management partly because the sector is in the jurisdiction of state and local government thereby constraining full federal intervention, as all tiers of government perform different functions in the sector. Excessive traffic demand is choking most cities even when car ownership is moderate due to poor city structure and narrow roads. Further increased traffic demand is expected in over 23 cities by the year 2030. Reforms are therefore needed to introduce economic regulation, corporatize public transportation, and adopt transport demand management measures in most cities. The creation of the Lagos Metropolitan Area Transport Authority (LAMATA) is highlighted as a model which other cities could adapt as an institutional framework for economic regulation and the management of transport demand.

Key words: urban transportation, infrastructure, transport demand, economic regulation, LAMATA

地铁换乘站公交调度研究

赵建有，李依
（长安大学）

摘　要：目前城市地铁线路呈增加趋势，多线路间大量乘客换乘使得换乘站拥挤严重，降低了居民出行舒适度，同时不连续换乘增加了出行时间。本文权衡地铁与乘客双方利益，以发车间隔和等待时间为变量，构建了多目标多变量的地铁调度优化模型，采用遗传算法和 Matlab 实现了模型求解。以西安市地铁 2 号线和 3 号线为例，得到了不同时段、不同乘客构成比例下的运营方案，为西安市地铁运营部门提供了调度计划参考。

关键词：遗传算法；Matlab 仿真；地铁换乘；协同调度

Study on Metro Transfer Station Time Scheduling

Zhao Jianyou , Li Yi
（Chang'an University）

Abstract:

At present, the number of subway lines in the city is increasing. A large number of passenger transfers between multiple lines make the transfer station crowded, reducing the comfort of residents.Simultaneously, non-continuous transfer increase travel time.Considering the interests of both subway and passengers, this paper takes the departure interval and passenger waiting time as variables, constructs a multi-objective and multi-variable subway scheduling optimization model, and uses genetic algorithm and Matlab to solve it. Taking Xi 'an metro line 2 and line 3 as an example, the simulation results show the operation schemes with different time periods and different proportions of passengers, which provides a reference for Xi 'an metro operation department.

keywords: genetic algorithm; Matlab simulation; subway transfer; collaborative scheduling

作者简介：赵建有，长安大学，jyzhao@chd. edu. cn。

Accurate Vehicle Detection for Autonomous Vehicle: Fusion of 3D-LIDAR and Camera Data

pengpeng sun (China)
长安大学
pengpeng.sun@chd.edu.cn

Jialin Liu (China)
jialin.liu@chd.edu.cn

Zhigang Xu (China)
zgx@chd.edu.cn

Xiangmo Zhao (China)
xmz@chd.edu.cn

Abstract： The ability to perform long-range and high accuracy vehicle detection in autonomous driving scenario is vital for autonomous vehicles. This paper presents a computationally efficient framework to detect vehicle natively using the complementary information of 3D LIDAR and camera data. Specifically, 3D LIDAR is utilized to generate precise object-region proposals by processing the 3D point clouds that it provides. Those candidate proposals are further processed by a multi-scale convolutional neural network (CNN) classifier for classification. Extensively experiments on the challenging KITTI object benchmark dataset have been carried out to evaluate the proposed method. The experiments show that 3D LIDAR can provide less but more precise object-region proposals, which can reduce the number of false positives for vehicle detection and remain highly competitively with respect to process time. Our proposed method achieved classification performance with 88.43% Average Precision in the moderate vehicle detection level of the KITTI benchmark dataset, which outperform most of the previous methods.

Key words： autonomous Vehicle; vehicle detection; object Identification; sensor Fusion; 3D LIDAR

A Interactive Simulation of Autonomous Vehicles Based on Midified Social Forces in Mixed Traffic

Fan Xinmiao，He Wu
四川师范大学

Abstract： One key challenge for autonomous vehicles driven in the real world is how to interact with human-driven vehicles, due to the uncertainties of human drivers' behaviors. In addition, in the process of lane changing, driving style is predictive for driving behaviors. Inspired by this observation, a driving style based interactive simulation framework is developed in this paper, which can simulate micro-lane-changing behaviors of drivers with different driving styles. Moreover, autonomous vehicles are able to identify the driving styles of human-driven vehicles online and then the a modified social force model is used to control the autonomous vehicle in order to realize cooperative lane change. Firstly, the Driver Behavior Questionnaire was utilised to classify the driving styles of 64 drivers into three different types: conservative, normal, and aggressive. Then we collected their driving performances in urban driving environment by driving simulator. Secondly, we built a Support Vector Machine model based on the driving performances to identify the driving style of human-driven vehicles. Thirdly, the human-driven vehicles lane changing model and autonomous vehicles control algorithm are proposed. Lastly, the simulation results show that our algorithm can eliminate the negative effect of lane change and improve the safety and smoothness of autonomous vehicles. Moreover, by comparing with the previous traffic simulation based on social forces, our method can effectively generate interactive and realistic traffic simulations.

Key words： Autonomous Vehicle; Mixed traffic; Traffic Simulation; Lane Change; Social Force Model

作者简介：范鑫淼，四川师范大学，857649132@qq.com。

车道保持系统联合仿真研究

季鑫，叶茂
（长安大学）

摘 要：为了减少驾驶人分心或疲劳造成的车道偏离事故，提出一种车道保持控制系统。根据道路线性将道路分为直线路段和曲线路段，利用跨道时间来判断车辆是否偏离车道；驾驶员的操作状态根据转向灯信号及转矩信号来进行判断。综合车道偏离信息与驾驶员操作信息来判断车道保持系统是否工作；车道保持系统的控制策略采用单点预瞄最优曲率驾驶员模型。仿真结果表明，模型能够实现车道保持功能。

关键词：车道保持系统

Joint Simulation of Lane Keeping System

Ji Xin, Ye Mao
(Chang'an University)

Abstract:

In order to reduce lane departure accidents caused by driver distraction or fatigue, we study Lane Keeping Assistance System. This article divides the road into straight sections and curved sections according to road linearity, and uses cross-lane time to judge whether the vehicle is in danger of deviating from the lane. The driver's operation state is judged based on the signal signal and the torque signal, and the information of the lane departure is combined with the driver's operation information to judge whether the lane keeping system is working. The control strategy of lane holding system adopts the optimal curvature driver model with single point preview. Simulation results show that the model can realize lane keeping function.

keywords: Lane-keeping system

作者简介:季鑫，长安大学，jxym96@163.com。

自动驾驶汽车在公路施工作业区的协调控制模型

侯兆凯，赵永平
（长安大学公路学院）

摘 要：每当公路中出现施工作业区或交通事故等场景的时候，车道就会被占用从而导致车道数的减少。车辆通过这种“瓶颈”路段时就必须进行减速及变道，这些操作必定会影响交通流的稳定以及车辆行驶的安全。自动驾驶汽车中运用的车联网技术可以使车辆与车辆间及车辆与道路间进行信息的实时交互，车辆可以根据接受到的信息以预定的交通流形式通过不利区域，从而使交通稳定，安全度提高。本文以高等级公路封闭外侧车道为研究对象，提出并建立协调控制模型。在本研究场景下，该模型假设车辆在到达施工区域前，先组成两列等距车队，基于本文提供的协调控制方案，推导出了加减速度、间距最小控制值以及车头间距应满足的条件等参数指标，为智能交通的研发工作提供参考。

关键词：公路施工作业区；自动驾驶汽车；协调控制模型

Coordinated Control Model of Autopilot Vehicle in Highway Construction Area

Hou Zhaokai，Zhao Yongping
(Chang'an University)

Abstract:

Whenever there are scenes such as construction work area or traffic accident in highway, the lane will be occupied and the number of lanes will be reduced. Vehicles must decelerate and change lanes when passing through this "bottleneck" section. These operations will inevitably affect the stability of traffic flow and the safety of vehicles. The technology of Internet of vehicles in autopilot can enable real-time interaction between vehicles and vehicles and between vehicles and roads. Vehicles can pass through unfavorable areas in the form of predetermined traffic flow according to the information they receive, thus enabling traffic to be stable and safe. This paper takes the closed outer lane of high-grade highway as the research object, and proposes and establishes a coordinated control model. In this research scenario, the model assumes that two equal-distance fleets are formed before the vehicle arrives at the construction area. Based on the coordinated control scheme provided in this paper, parameters such as acceleration and deceleration, minimum control value of spacing and the conditions that the headway spacing should meet are deduced, which can provide reference for the research and development of intelligent transportation..

keywords: Highway construction area; Autopilot; Coordination Control Model

作者简介:侯兆凯，长安大学公路学院， 1501142640@qq. com。

适用于网约车的行车安全辅助系统

汤伟健，徐鹏，罗中萍
（中设设计集团股份有限公司；河海大学 中设设计集团股份有限公司）

摘 要：基于网约车数量的快速增加，交通事故率居高不下的情况，着眼于怎样帮助网约车司机安全驾驶，突出交通分析在辅助驾驶中的作用，以分析影响驾驶安全的各类因素并建立准确实时的安全车距模型、实现低能见度下行车视距判别为特色。提出一套准确安全、低成本、易安装使用的解决方案，研发行车安全辅助系统。系统充分考虑包括驾驶员个体差异和行车环境等多因素在内的交通实际状况，建立了基于实际状况的安全车距模型，通过双目定距算法实现车辆间距实时检测，通过神经网络机器学习判定低能见度下行车视距与司机行为监测、通过 OBD 接口进行车辆监控，当车辆面临危险隐患时对司机提示告警。

关键词：交通安全；网约车；行车安全辅助系统

Driving Safety Assist System for Ride-Hailing Cars

Tang Weijian, Xu Peng, Luo Zhongping
(CHINA DESIGN GROUP CO.,LTD.; Hohai University CHINA DESIGN GROUP CO.,LTD)

Abstract:

Based on the rapid increase of the number of vehicles in the network and the high traffic accident rate, we will focus on how to help the drivers of the network to drive safely, highlight the role of traffic analysis in assisted driving, and analyze various factors affecting driving safety. And to establish an accurate real-time safety distance model, to achieve low visibility vehicle line of sight discrimination. Propose a set of solutions that are accurate, safe, low-cost, easy to install and use, and develop a driving safety assistance system. The system fully considers the actual traffic conditions including the individual differences of the driver and the driving environment, establishes a safe distance model based on the actual situation, realizes the real-time detection of the vehicle distance through the binocular distance algorithm, and determines the neural network machine learning. Low-visibility vehicle line-of-sight and driver behavior monitoring, vehicle monitoring through the OBD interface, alerting the driver when the vehicle is at risk.

keywords: traffic safety; ride-hailing cars; driving safety assist system

作者简介:汤伟健，中设设计集团股份有限公司，twjs_1915@126.com。

自动驾驶环境下车辆换道研究成果综述

张琳，马庆禄
（重庆交通大学）

摘 要：建立车辆换道的相关模型可以提高车辆换道的效率，针对自动驾驶车辆不同的换道研究结果，本文进行了综述。首先，总结分析了车辆抽象化后所得的四种车辆模型，同时将智能车辆换道过程详细地分为跟驰期、半过渡期、松弛期、换道期四种不同的阶段；然后，将自动驾驶车辆换道模型分为车辆跟驰模型和换道轨迹模型两大类，对两类自动驾驶车辆换道算法模型进行了总结，分析了各种模型的特点；最后，对未来研究自动驾驶车辆换道模型的发展趋势提出了简单的想法，即未来自动驾驶换道模型的研究会针对不同的环境建立有更强针对性及适用性的模型，同时未来自动驾驶车辆换道模型将利用大数据、深度学习、人工智能等技术由静态模型向着动态模型发展。

关键词：车辆换道；自动驾驶；车辆跟驰模型；换道轨迹模型；车辆换道阶段

A Summary of Research Achievements on Vehicle Lane Change in Auto-Driving Environment

Zhang Lin, Ma Qinglu
(Chongqing Jiaotong University)

Abstract:

Establishing relevant models of vehicle lane-changing can improve the efficiency of vehicle lane-changing. This paper summarizes the research results of different lane-changing for automatic driving vehicles. Firstly, the four vehicle models obtained from vehicle abstraction are summarized and analyzed. At the same time, the intelligent vehicle lane-changing process is divided into four different stages, which are following period, half-transition period, relaxation period and lane-changing period. Then, the automatic driving vehicle lane-changing model is divided into car-following model and lane-changing trajectory model, and the two kinds of automatic driving vehicle lane-changing algorithm models are summarized. In conclusion, the characteristics of various models are analyzed respectively. Finally, a simple idea is put forward for the development trend of future research on automatic driving vehicle lane-changing model. In the future, research on automatic driving lane-changing model will establish more pertinent and applicable models for different environments. At the same time, automatic driving vehicle lane-changing model will use large data, in-depth learning, artificial intelligence and other technologies achieving the changes from Static Model to Dynamic Model, in the future.

keywords: vehicle lane-changing; automatic driving; car-following model; lane-changing trajectory model; vehicle lane change phase

作者简介：张琳，重庆交通大学，1023496958@qq.com。

农村公路全生命周期管理信息系统设计及应用

刘振华, 刘柳, 杨范, 文涛, 崔应寿
（交通运输部科学研究院）

摘 要：建设“四好农村路”是中国目前脱贫攻坚战略的重要组成部分。农村公路建设具有总规模庞大、单个项目小、地理位置偏远的特点，管理难度远超大型交通基础设施。在充分考虑现阶段农村公路管理需求的基础上，设计了一套信息系统，涵盖了计划、招标、进度、资金、验收、养护等各项业务，并应用了地理信息技术、遥感影像处理技术、移动互联技术等现代信息技术，可对农村公路进行高效的全生命周期管理。系统在部分省份进行了应用，取得了良好效果，为各省对农村公路开展精细化管理提供了有效的技术手段。

关键词：农村公路；全生命周期管理；信息系统；遥感；地理信息系统

Design and Application of Rural Roads Lifecycle Management Information System

Liu zhenhua, Liu Liu, Yang Fan, Wen Tao, Cui Yingshou
(China Academy of Transportation Sciences)

Abstract:

Building good rural roads is an important part of China's current strategy to fight poverty. Rural roads construction has a large scale, but each single project is small. And rural roads are usually located in remote areas. So rural roads management is far more difficult than large transportation infrastructures. Considering the needs of rural roads management at the present stage, we designed an information system, which covers planning, bidding, progress management, funds management, project acceptance, road maintenance and other business to realize the life cycle management of rural roads. We applied modern information technology such as GIS technology, remote sensing image processing technology, mobile internet technology in this system. The system has been applied in some provinces and achieved good results which show that it can provide an effective technical means for fine management of rural roads.

keywords: rural roads; life cycle management; information system; remote sensing; geographic information system

作者简介:刘振华，交通运输部科学研究院，liuzhenhua@catsic.com。

Research on Intelligent Parking System Algorithm Based on Camera Calibration Model

Wang Duo, Hong Chen, Hu Yang, Shu Qixue
Chang'an University, Chang'an University, 陕西省城乡规划设计研究院, Chang'an University

Abstract: This paper has analyzed the intelligent parking system algorithm based on camera calibration model. The camera model has been established, the initial calibration image collection is acquired by the initial image generation module, the calibration image is updated according to the output of the error analysis module, and the accuracy analysis module is used to determine whether the algorithm is over. Through the initialization, real-time updating and real-time arrangement of the time windows of the feasible paths, the collision-free path planning of multiple AGVs is realized. Experiments show that the proposed method has better robustness and flexibility and effectively improves the overall operation efficiency of intelligent parking system.

Key words: camera calibration model; intelligent parking; parking system algorithm; camera model

作者简介：王铎，长安大学，tracywangduo@chd.edu.cn。

基于蓝牙技术的共享单车规范化停车管理系统

卞巍皓，阳若淼，康子良，韩佳芮
（长安大学）

摘 要：共享单车具有随用随骑、无停车桩约束、费用低廉和低碳环保的优势，较好解决了城市居民“最后一公里”的出行问题，降低了出行者对机动车的依赖性，为改善城市环境和缓解交通拥堵做出了极大贡献。但共享单车的乱停乱放、公车私用、恶意破坏等不当现象，也给城市市容环境、道路交通秩序造成了不利影响。为引导共享单车使用者规范停车、合理用车，提出一种基于蓝牙技术的共享单车规范化停车管理系统。该系统通过利用停车区域安装的蓝牙信号读卡器和共享单车车身上的蓝牙接近开关，诱导共享单车使用者将车辆停放在交通管理部门施画的停车区域内。当共享单车停放在所规定区域时，蓝牙信号读卡器与蓝牙接近开关实现适配，平台停止对共享单车用户扣费；当共享单车未停放在规定区域时，二者无法实现适配，并且违停信号会被上传至后台服务器，用户会被继续扣费。同时，该系统通过坐标转化调节蓝牙发射器的覆盖范围，实现信号覆盖区域与施画的停车区域相吻合。本系统对引导共享单车有序发展，改善城市交通环境具有重要实用价值。

关键词：共享单车；蓝牙发射器；蓝牙接近开关；规范化停车；坐标转化

Standardized Parking Management System of Shared Bicycle Based on Bluetooth Technology

Bian Weihao, Yang Ruomiao, Kang Ziliang, Han Jiarui
(Chang'an University)

Abstract:

With the rapid development of urban traffic, the problem of the last kilometer is becoming more and more serious.Shared bikes came into being to solve this problem. With the advantages of following use, no parking pile constraint, low cost and low carbon environment protection, Shared bikes rapidly affect the daily life of urban residents. On the one hand, Shared bicycles can effectively solve the problem of "last mile" travel, reduce the traveler's dependence on motor vehicles, and make a great contribution to improving urban environment and easing traffic congestion.On the other hand, disorderly parking, private use of buses and malicious destruction not only restrict the healthy and orderly development of Shared bicycles, but also bring adverse impact on the city environment and road traffic order. Therefore, in order to control and manage the parking area of Shared bicycle, we developed a standard parking management system based on bluetooth technology.According to the parking area of the bluetooth signal between the reader and the bluetooth proximity switch on the bike adaptation behavior, make sure the bicycle to park successfully in a specified area, if not successful adaptation to parking lock is not upload signal back to the server, background continues deduction, prompt the user to stop violations behavior, looking for parking planning parking space, at the same time, through coordinate transformation method to control the size and shape of the parking areas. The system realizes the limitation of the Shared bicycle parking area, and the alarm function of unstandardized parking for users is realized through

the interaction between the adaption of the bluetooth module, the parking lock and the bluetooth proximity switch. When this product is put into the market, it will regulate the parking behavior of users, and thus generate a variety of potential social benefits.

keywords: Shared bikes; Bluetooth technology; Bluetooth proximity switch; Regulated parking; Coordinate transformation

作者简介:卞巍皓，长安大学，1075931881@qq.com。

基于列车运行实绩数据的列车晚点恢复时间预测模型

胡雨欣，彭其渊，鲁工圆，李力
（西南交通大学）

摘 要：列车初始晚点严重程度和运行图冗余时间配置两方面因素是列车晚点恢复时间长短的重要影响因素。本文基于高速铁路列车运行实绩数据，以初始晚点时间、站停冗余时间和区间冗余时间为变量，使用多层感知器（MLP）和循环神经网络（RNN）建立了列车晚点恢复时间预测模型，采用了基于运行图历史数据的冗余时间近似统计方法，提高统计精度，降低了运行图参数数据采集的工作量成本。基于广深港铁路 12 个月列车运行实绩数据进行了列车晚点恢复时间预测试验，结果表明：允许误差为 1 分钟时，MLP 模型预测精度为 91.6%；允许误差为 3 分钟时，RNN 模型表现更好，预测精度在 95%以上。

关键词：高速铁路；晚点恢复；运行实绩数据；MLP；RNN

Train Delay Recovery Time Prediction Model Based on Train Operation Records

Hu Yuxin, Peng Qiyuan, Lu Gongyuan, Li Li
(Southwest Jiaotong University)

Abstract:

The two factors of the initial delay of the train and the redundant configuration of the operation map are the important factors affecting the length of train recovery time. Based on the high-speed railway train operation records, this paper studies the influencing factors of train delay recovery.Three factors——the initial late time, station stop redundancy time and interval redundancy time are important links that affect train delay recovery.Based on the high-speed railway train operation data, this paper uses the multi-layer perceptron (MLP) and the cyclic neural network (RNN) to establish the train late recovery time prediction model with the initial late time, station stop redundancy time and interval redundancy time as variables. The redundant time approximation statistical method based on the historical data of the running graph is adopted to improve the statistical precision and reduce the workload cost of the data collection of the running graph parameters. Based on the 12-month train operation data of Guangzhou-Shenzhen-Hong Kong Railway, the train late recovery time prediction test was carried out. The results show that the prediction accuracy of the MLP model is 91.6% when the allowable error is 1 minute, and the RNN model is more accurate when the allowable error is 3 minutes. Well, the prediction accuracy is above 95%.

keywords: High-speed railway; Delay recovery; Operation record; MLP; RNN

作者简介:胡雨欣，西南交通大学, 996236884@qq. com。

交通气象与智慧公路建设

娄胜利
（象谱信息产业有限公司）

摘 要：公路建设事业发展迅速，对我国的经济发展、国防建设和人民生活水平的提高都发挥了显著作用，然而，现代交通运输所追求的快速、高效与安全目标，往往受到气象条件的影响和制约。与传统道路管理相比，智慧公路最大的特点在于运用多种信息传输设备，以信息的收集、处理、发布及分析为主线，为交通参与者提供了多样化的服务，让交通更高效，更安全。

关键词：智慧公路

Traffic Meteorology and Intelligent Highway Construction

Lou Shengli
(象谱信息产业有限公司)

Abstract:

The rapid development of highway construction has played a significant role in China's economic development, national defense construction and the improvement of people's living standards. However, the fast, efficient and safe goals pursued by modern transportation are often influenced and constrained by meteorological conditions.

Compared with traditional road management, the most important feature of intelligent highway is to use a variety of information transmission equipment, with the collection, processing, distribution and analysis of information as the main line, to provide a variety of services for traffic participants, so that traffic is more efficient and safer.

keywords: Intelligent Highway Construction

作者简介:娄胜利，象谱信息产业有限公司，jinh@weatbook.com。

ETC 自由流收费技术在高速公路应用探讨

伍尚干，苏少勇
（广东广珠西线高速公路有限公司）

摘 要：本文是对目前高速公路 ETC 收费技术发展现状进行分析，以 ETC 自由流收费技术的应用实例说明应用成果，探讨 ETC 自由流收费技术的应用的可行性，并对高速公路 ETC 自由流收费技术为取消省界收费站解决方式提供参考。

关键词：ETC；收费技术；自由流

Application of ETC Free Flow Toll Technology in Expressway

Wu Shanggan, Su Shaoyong
(广东广珠西线高速公路有限公司)

Abstract:

This paper analyses the current development status of ETC toll collection technology on expressway, illustrates the application results with an example of ETC free flow toll collection technology, explores the feasibility of ETC free flow toll collection technology application, and provides a reference for eliminating provincial toll stations by ETC free flow toll collection technology on expressway.

keywords: ETC; charging technology; free flow

作者简介:伍尚干，广东广珠西线高速公路有限公司，124738040@qq.com。

Improved Method of Lane Recognition Based on Background Filtering of Road Edge Image

Wu Huayue, Zhao Xiangmo
Chang'an University
whyinvr@126.com

Abstract: The image of lane edge obtained by using edge detection method includes lots of background and irrelevant edges, using such image for lane recognition will be inaccurate and time-consuming. An adaptive lane edge extraction method is proposed which could better extract lane edges and only a few non-lane edges remain. A method for searching lanes in edge image is also proposed to segment the edge image, and the effect of filtering the edges of non-lane could be obtained by remaining the longest region. At last parallel coordinate system and quadratic curve model are used to detect straight and curved lines in the edge image, which could greatly improve lane recognition efficiency. When proposed methods are applied to extract and filter the edges of road image, non-lane edges could be effectively filtered, enhancing the ability of lane recognition for the road with imaginary lanes, rainwater, stain and shadow, light interference at night, multiple vehicles, and could significantly promote the recognition speed.

Key words: Traffic information engineering and control; Lane recognition; Adaptive lane edge extraction; Searching and statistics of lane; Parallel coordinate system; Quadratic curve model

Application of Alinea Ramp Control Algorithm for Type C Weaving Sections

Wu Jiangling (China)
Henan University
wujiangling_2006@126.com

Amit Kumar Singh (United States of America)
Atkins North America, Inc.
AmitKumar.Singh@atkinsglobal.com

Yuan Yuqing (China)
Henan University
yroad@126.com

Wang Huan (China)
Henan University
happy_king0924@sina.com

Li Weijia (China)
Chang'an University
liweijiachd@126.com

Abstract : Type C weaving sections which are typically located near freeway-freeway interchanges have high weaving demand volume, which leads to severe bottlenecks. Ramp metering (RM) has emerged as a popular active traffic management strategy, and ample research has been devoted to developing ramp metering control algorithms. However, the application of RM control algorithms for type C weaving sections has received limited attention. A conventional RM control algorithm focuses on maintaining desired speed on all lanes of the main-lane by controlling the entry volumes, which works well for entry ramps near merge areas or type A weaving sections but not at Type C weaving sections. Therefore, a modified local RM control strategy, which is specifically designed to improve the traffic conditions within type C weaving areas, is proposed. The traffic operation characteristics within a type C weaving section are explored in detail. Asservissement Linéaire d'Entrée Autoroutière (ALINEA) is used to study the proposed RM strategy at three C-type weaving sections located in Los Angeles, California. VISSIM simulation results show the modified ALINEA strategy provides a better level of service than the conventional ALINEA methodology and can improve the traffic operations within the type C weaving area by directly addressing the heavy lane changes. For modified ALINEA strategy, the study recommends the desired occupancy value of 30 percent for the type C weaving section. A demand sensitivity analysis is performed to study and optimize the operation of ramp meter with higher main-lane demands.

Key words: Ramp Metering; Asservissement Linéaire d'Entrée Autoroutière; Weaving Section; Highway Capacity Manual

基于 Mask R-CNN 的交通标线识别

张山,沈照庆
（长安大学）

摘要：本文提出了一种基于 Mask R-CNN 框架对交通标线进行实例分割的方法。Mask R-CNN 是 Faster R-CNN 的扩展形式，能够有效地检测图像中的目标，同时还能为每个实例生成一个高质量的分割掩码。因此，使用 Mask R-CNN 做图像识别时在检测物体边界的同时还能用语义分割给像素分类，确定出物体的含义。本文的方法能有效的在实际场景当中检测并识别出交通标线，而且实验结果表明：与传统方法相比较，使用 Mask R-CNN 框架进行标线识别有着准确率更高，速度更快的优势。

关键词：实例分割；交通标线；神经网络

Traffic Line Identification Based on Neural Network

Zhang Shan, Shen Zhaoqing
(Chang'an University)

Abstract:

This paper presents a method of traffic line segmentation based on Mask R-CNN framework. The Mask R-CNN is an expanded form of Faster R-CNN, can effectively detect the target in the image, also generates a high quality segmentation mask for each instance. Therefore, when using Mask R-CNN for image recognition, the pixel can be classified by semantic segmentation while object boundary is detected, identify the meaning of the object. The method in this paper can effectively detect and identify traffic lines in the actual scene, and the experimental results show: compared to the traditional method, the use of Mask R-CNN framework for line marking identification has the advantages of higher accuracy and faster speed.

keywords: examples of segmentation; traffic line markings; neural network

作者简介:张山，长安大学，2277391709@qq.com。

Robust Road Detection Based on Monocular Depth Estimation Model and Improved U-V View

Song Yongchao (China)
Chang'an University
2015132047@chd.edu.cn

Ju Yongfeng (China)
Chang'an University
yfju@chd.edu.cn

Jiang Yahong (China)
Chang'an University
2543138936@qq.com

Du Kai (China)
Chang'an University
dukai@chd.edu.cn

Abstract: In order to solve the problem of large matching error and high computational complexity of binocular disparity map in real traffic environment, a simple, accurate and universal detection method is obtained. This paper proposes a road detection algorithm combining monocular depth estimation model and improved U-V view. We obtain the original disparity map using an unsupervised monocular depth estimation model based on left and right consistency, and the initial U-V views are defined by horizontal and vertical projection of original disparity map. We adapt improved U and V view methods, and the final V view is constructed through obstacle removal, view inverse transformation, and noise removal. The geometrical characteristics are used to determine the position of the horizon and the initial contour of the road, and road detection result is obtained through error label reclassification, omitting point reassignment and so an. The validity of the proposed method is tested under the KITTI standard dataset. The experimental results show that the accuracy rate P, the recall rate R and the comprehensive evaluation index F are better than those in the literature [10], and the comprehensive evaluation index F value reaches 95.51%. The volatility is small and runtime is about 170ms, which can meet the actual scene detection requirements.

Key words: traffic information engineering; intelligent driving; road detection; stereo vision; monocular depth estimation; U-V view

平曲线路段下突起路标摆放角度对视线诱导效果是否有影响

张栋
（长安大学）

摘 要：突起路标不同的摆放角度对应不同的光线入射角度，会影响突起路标的逆反射性能。为了探究在平曲线路段调整突起路标的摆放角度能否提高对驾驶人的视线诱导效果，本文确定了突起路标达到最佳逆反射效果时的状态条件，分析了夜间驾驶人的可视范围，计算了最佳逆反射效果摆放时与沿径向（通常情形）摆放时的突起路标摆放角度与光线入射角度，并对入射角度进行了对比。计算结果表明：两种安装方式下的入射角差值随半径的增大而减小，最大差值为 5.9°。利用 STT-201A 型突起路标测量仪对入射角变化时的逆反射改善效果进行了分析，得出当入射角每减小 5.9°，观测角小于 2° 情况下的发光强度系数平均提高比例仅为 12.6%，逆反射改善效果不明显。因此，通过调整突起路标的摆放角度无法明显提高驾驶员对道路线形的感知。

关键词：突起路标

Whether the Installation Angle of Raised Pavement Markers on a Horizontal Curve Section Has an Effect on the Line of Sight Induction Performance

Zhang Dong
(Chang'an University)

Abstract:

Different installation angles of raised pavement markers (RPMs) correspond to different incident angles of light, which affects the retroreflective performance of the RPMs. This paper explores how adjustments to the installation angle of the RPMs on a horizontal curve section affect the driver's line of sight induction. The conditions under which RPMs achieve the optimal effect of retroreflection are confirmed, the driver's visual range at night is analyzed, and the incident angle of light and installation angle of the RPMs when the optimal effect of the retroreflection is achieved and the RPMs are installed along the radial direction (normal conditions) are measured. The differences of the incident angles were compared. The results show that the difference in the incident angle under the two installment modes decreases with increases in the radius, with a maximum value of 5.9°. The improvement effect of the retroreflection with variations in the incident angle is analyzed using the STT-201A RPM measuring instrument. When the incident angle is decreased by 5.9°, and the observed angle is less than 2°, the average increase in the coefficient of the luminous intensity is only 12.61%, indicating that the improvement effect of the retroreflection is not obvious. Therefore, the driver's perception of the road alignment cannot be significantly improved by adjusting the installation angle of the RPMs.

keywords: raised pavement marker

作者简介：张栋，长安大学，2017221156@chd. edu. cn。

道路线形组合复杂路段风险评估及预警模型研究

任晓玮，张驰，许甜，冯逸伟，吕茂
（长安大学长安大学，中交第一公路勘察设计研究院有限公司；长安大学长安大学）

摘 要：为减少公路线形组合复杂路段的行车风险，研究了线形组合复杂路段风险评估及预警模型，本文基于线形组合复杂路段的线形特点及事故类型，结合高精度 GPS 技术所能获取的交通数据，选取了包括速度离散性和交通冲突等风险评估及预警指标，采用模糊评价法构建了风险评估及预警模型。在 VISSIM 平台进行仿真试验分析，试验结果表明该模型对线形组合复杂路段的行车风险及风险预警有着良好的评估，适用性较好。建立的风险评估与预警模型可结合车载终端等途径，实现对公路线形组合复杂路段车辆的自动预警。

关键词：公路工程；线形组合；风险评估；预警；VISSIM

Research on the Risk Assessment and Early Warning of Road Linear Combination Complex Section

Ren Xiaowei, Zhang Chi, Tian Xu, Feng Yiwei, Lv Mao
(Chang'an University; Chang'an University; 中交第一公路勘察设计研究院有限公司; Chang'an University; Chang'an University)

Abstract:
In order to reduce the traffic risk of complex road sections with linear combination, the risk assessment and early warning model of complex sections with linear combination are studied. Based on the linear characteristics and accident types of complex sections, combined with the traffic data that can be obtained by high-precision GPS technology, this paper selects the traffic data. Including risk assessment and early warning indicators such as speed dispersion and traffic conflict, the risk assessment and early warning model is constructed by fuzzy evaluation method. The simulation test is carried out on the VISSIM platform. The test results show that the model has a good evaluation of the traffic risk and risk warning of the complex combination of linear sections, and the applicability is good. The established risk assessment and early warning model can be combined with the vehicle terminal to achieve automatic warning of vehicles with complex road sections.
keywords: Highway engineering; Linear combination; risk assessment; Early warning; VISSIM

作者简介:任晓玮，长安大学，675435759@qq. com。

浅析高速公路服务区危化车辆停放

鱼晓华，杨晨光，张尚勇
（陕西省交通建设集团公司）

摘 要：高速公路服务区作为现代温馨驿站，为运输车辆和途经旅客提供了重要的补给和休憩场地，危化车辆作为运输重磅之特殊车辆，停放到人员、车辆集散之地服务区，不得不引起高度关注。作为一个重大安全隐患源，一旦发生事故，后果不堪设想。怎样规划好、预防好、管理好危化车辆停放，是服务区相关部门安全管理的重中之重，也是亟需探析的问题。

关键词：公路服务区；危化车停放；安全管理

An Analysis on Dangerous Vehicles Parking in Expressway Service Area

Yu Xiaohua, Yang Chenguang, Zhang Shangyong
(陕西省交通建设集团公司)

Abstract:

The expressway service area，as a modern and warm station，provides important supplies and leisure venues for transport vehicles and passengers.Dangerous vehicles as special vehicles for heavy transportation have to be highly concerned when parked in the service area of distributed center. As a major source of security risks, once an accident occurs, the consequences are unimaginable. How to plan, prevent, and manage the parking of dangerous vehicles is the top priority in the safety management of relevant departments in the service area, and it is also an urgent problem.

keywords: expressway service area;the parking of dangerous vehicles;safety management;expressway service area;the parking of dangerous vehicles;safety management

作者简介:鱼晓华，陕西省交通建设集团公司，18292967895@163.com。

非对称路面对制动效能影响的仿真分析

徐磊，朱科，王琛玮，李青林，彭金栓
（重庆交通大学）

摘 要：针对传统制动性能分析并未涉及路面因素，提出将路面激励非对称度作为制动性能影响因子，利用 Carsim 联合 Simulink 对非对称路面下车辆制动效能进行仿真分析。以典型路面激励作为参考基准，在 Simulink 中构建路面激励可控的车辆制动模型。为保证前后车轮能够以相同概率遍历同一路面，依据车速和轴距确定时间延迟；根据模型计算出的当量方向盘转角界定非稳态制动跑偏，对不同路面激励下的制动减速度、制动距离进行仿真分析；并对路面激励的相关系数与跑偏车速以及制动衰减时间之间的关系进行分析。结果表明:在车速一定情况下，路面的非对称度与制动减速度波动性正相关，与制动距离负相关，且左右路面存在非对称度时，车辆更容易达到非稳态跑偏的临界车速，制动衰减时间与跑偏车速对相关系数在 0～0.2 内的路面激励特别敏感。

关键词：制动；非对称度；Carsim；路面激励；临界车速

Simulation and Analysis of Non-Symmetrical Road on Brake Performance

Zhu Lei, Zhu Ke, Wang Chenwei, Li Qinglin, Peng Jinshuan
(Chongqing Jiaotong University)

Abstract:

Because traditional brake performance analysis did not involve in road factors, this paper proposes that non-symmetrical degree of road input should be as an influence factor of brake performance and SIMULINK united with CarSim are used to simulate and analyze brake efficiency under non-symmetrical road input. The representative road input is to be as reference and vehicle brake model which road input can be controlled is established in SIMULINK. Speed and axle distance are adopted to determine time delay so that the front and rear tires can go through the same road surface at the same probability. The equivalent steering wheel angle calculated by the model is used to define non-stable brake deflection. Then, brake acceleration and brake distance under different road inputs are simulated and analyzed and the relationship among relevant coefficient, brake deflection speed and brake decay time are simulated and analyzed. The results show that non-symmetrical degree of road input is positive relevance with brake acceleration fluctuation and is negative relevance with brake distance. Moreover, if the left and right road surfaces are not symmetrical, vehicle can more easily achieve non-stable brake deflection critical speed. Brake decay time and deflection speed are more sensitive to road input which relevant coefficient varies from 0 and 0.2.

keywords: brake; non-symmetrical degree; CarSim; road input; critical speed

作者简介:徐磊，重庆交通大学，37951759@qq.com。

基于偏比例优势模型的山区高速多车事故严重程度影响因素研究

彭志鹏，余丽洁，田甜，王永岗
（长安大学）

摘 要：为了探究山区高速多车事故严重程度与相关影响因素之间的关系，以江西省三条山区高速2006到2015年的多车事故数据作为基础,将事故严重程度划分为仅财产损失(PDO)，人员受伤和人员死亡三个等级,建立偏比例优势模型来描述各因素对不同严重程度事故的影响。结果表明：模型的拟合度较好，偏比例优势模型可以放宽平行线假设条件，在这个前提下，性别，年龄，季节，是否为工作日，事故发生时间，车辆类别，天气，超速驾驶，疲劳驾驶，不保持安全距离等因素对事故严重程度有显著影响，且不同的因素对不同严重等级的事故影响不同，研究结论为未来交通安全治理可提供有效指导。

关键词：山区高速；事故严重程度；偏比例优势模型；交通安全

Study on the Influencing Factors about Injury Severity of Multi-Vehicle Accidents in Mountainous Areas

Peng Zhipeng, Yu Lijie, Tian Tian, Wang Yonggang
(Chang'an University)

Abstract:

In order to explore the relationship between the severity of high-speed multi-vehicle accidents in mountainous areas and various influencing factors, the accident severity was classified as only property loss (PDO), Injury and Fatality based on the data of multi-vehicle accidents from 2006 to 2015 in three Expressway of Jiangxi Province. A partial proportional model was established to describe the impact of various factors on injury severity of accidents. The results show that the model has good fitness, and the partial proportional model can relax the parallel line hypothesis. Under this premise, gender, age, season, whether it is working day, accident time, vehicle type, weather, speeding, fatigue driving, lack of safety distance and other factors have a significant impact on the severity of the accident, and different factors have different impacts on accidents between different severity levels. The research conclusions can provide favorable guidance for future traffic safety management.

keywords: Mountainous freeway; Accident severity; Partial proportional model; Traffic safety

作者简介:志鹏，长安大学，277430191@qq. com。

减少城市道路电动摩托车交通事故的举措分析

张焕炯
（浙江省交通运输科学研究院）

摘 要：随着城市电动摩托车交通事故的频繁发生，提升电动摩托车交通安全已成为了一个重要的安全课题。在深入分析城市电动摩托车交通事故原因的基础上，提出了一种基于技术进步的、可有效减少交通事故的具体举措和相应方法。

关键词：城市道路；电动摩托车；交通事故；交通安全

Some Synthetic Approaches of Decreasing Motorcycles Traffic Incidents on Urban Roads

Zhang Huanjiong
(浙江省交通运输科学研究院)

Abstract:

As traffic incidents of motorcycles frequently happen, increase the traffic security of motorcycles become an important researching topic. Based on analyzing the reasons of motorcycles traffic incidents, then some methods and measures of decreasing motorcycles traffic incidents on urban roads are pointed out.

keywords: Urban road; Motorcycles; Traffic Incident; Traffic Security

作者简介:张焕炯，浙江省交通运输科学研究院，1809316020@qq.com。

基于互联网+声测的重大交通事故一体化快速救援系统设计

凤鹏飞，金会庆
（安徽三联学院国家车辆驾驶安全工程技术研究中心）

摘 要：本文是在前期所研究的重大交通事故中声音特征提取分析基础之上，对产生重大交通事故后的快速救援方案的设计。重大交通事故发生瞬间，车辆碰撞声信号几乎是同时触发，通过声信号的特征识别确认产生交通事故后，自动启动交通事故定位和自动报警，通过事故现场救援平台、救援中心指挥平台、辅助救援平台、应急救援预案系统等一体化重大交通事故应急救援平台的构建，实现广域综合信息和资源在救援平台的指挥下快速的、有组织的、全方位的共享共用，形成快速救援的技术能力。同时一体化平台中，设计了事故现场快速勘测方法和快速救援预案系统，为事故现场的及时有效地鉴定和整个系统的快速救援优化提供了技术方案。

关键词：声信号；重大交通事故；一体化；快速救援；系统设计

Design of Rapid Rescue System for Major Traffic Accidents Based on Internet + Acoustic Measurement

Feng Pengfei, Jin Huiqing
(Anhui Sanlian university; 国家车辆驾驶安全工程技术研究中心)

Abstract:

This article is based on the analysis of sound features extracted from major traffic accidents studied in the earlier period.Design for a quick rescue plan after a major traffic accident.The moment of a major traffic accident, the vehicle collision sound signal is almost simultaneously triggered.Through the recognition of the characteristics of acoustic signals to confirm the occurrence of traffic accidents, automatically start the traffic accident location and automatic alarm.Through the accident scene rescue platform, the rescue center command platform, aids rescue platform, emergency rescue plan system and other integrated major accident emergency rescue platform construction.Realize the comprehensive, wide-area information and resources under the command of the rescue platform Fast, organized and comprehensive sharing and sharing, forming a rapid rescue technical capabilities.At the same time integration platform, the rapid accident scene survey method and rapid rescue plan system.It provides a technical solution for timely and effective identification of the accident site and rapid rescue optimization of the entire system.

keywords: Acoustic signal; Major traffic accident; Integration; Quick rescue; system design

作者简介:凤鹏飞，安徽三联学院，fengpengfei@126.com。

高速公路多车交通事故严重程度影响因素分析

张保硕，肖娜，王永岗
（长安大学）

摘 要：交通安全一直以来是国内外学者着力研究的主题，为了降低严重交通事故的发生概率，保障行车安全，根据中国江西省高速公路某年的多车事故统计资料，以交通事故严重程度为因变量，从人、车、路、环境 4 个方面选取了 17 个候选自变量，并通过逐步回归筛选影响显著的自变量建立有序 logit 模型，同时运用多层感知器神经网络算法进一步验证所得结论。结论表明：驾驶员未能与前车保持合理车距是诱发严重交通事故的最重要因素，同时，不良天气、驾驶非法车辆、超速等也使严重事故发生的概率明显增加。最后，结合所得结论针对性的提出了一系列降低严重交通事故发生概率的对策及方案。

关键词：交通安全；事故严重程度；逐步回归；有序 logit 模型；神经网络

Analysis of the Factors Affecting the Severity of Multi-Vehicle Traffic Accidents on Expressways

Zhang Baoshuo, XiaoNa, Wang Yonggang
(Chang'an University)

Abstract:

Traffic safety has always been the subject of research by scholars at home and abroad. In order to reduce the probability of serious traffic accidents and ensure the safety of driving, according to the statistics of multi-vehicle accidents in a certain year of highways in Jiangxi Province of China, the severity of traffic accidents is the dependent variable. Seventeen candidate independent variables were selected from four aspects: human, vehicle, road and environment. The orderly logit model was established by stepwise regression screening to influence the significant independent variables. The multi-layer perceptron neural network algorithm was used to further verify the conclusions. The conclusions show that the driver's failure to maintain a reasonable distance from the preceding vehicle is the most important factor in inducing serious traffic accidents. At the same time, bad weather, driving illegal vehicles, speeding, etc. also increase the probability of serious accidents. Finally, combined with the conclusions obtained, a series of countermeasures and solutions to reduce the probability of serious traffic accidents are proposed.

keywords: Traffic safety; severity of accident; stepwise regression; ordered logit model; neural network

作者简介：张保硕，长安大学，823481799@qq. com。

Prediction of Lane-Changing Behavior Based on Driver's Maneuvering Characteristics and Relative Motion Parameters

Peng Jinshuan (China)
重庆交通大学
pengjinshuan@163.com

Li Qinglin (China)
重庆交通大学
997865106@qq.com

Zhu Ke (China)
重庆交通大学
547333741@qq.com

Wang Chenwei (China)
重庆交通大学
741096435@qq.com

Xu Lei (China)
重庆交通大学
37951759@qq.com

Abstract: In order to avoid the occurrence of traffic accidents caused by improper lane-changing operations, based on the analysis of maneuvering characteristics and relative motion states, a new method to identify drivers' lane-changing behavior was proposed. Relying on actual vehicle road test data, drivers' visual characteristics and data analysis were combined to set an intent window width of 5 s. Based on the difference in maneuvering characteristics and relative motion parameters between the lane-keeping and lane-changing intent stages, a characterization index system was constructed, consisting of a two-element logistic model to determine the regression coefficient of each parameter and predict lane-changing behavior. The results show that the model may effectively predict drivers' lane-changing behavior at least 2.5 s in advance, with a prediction accuracy of 96.34%. Compared with prediction of lane-changing behavior based on visual characteristics and turn signal states, this model has higher prediction accuracy and better time series characteristics.

Key words: intent time window; lane-changing behavior; predictive index; logistic model; time series characteristics

高密度高负荷小间距互通立交区安全评价方法及改善措施研究

许甜，邓涵月，骆中斌，马小龙
（中交第一公路勘察设计研究院有限公司）

摘要：针对高密度高负荷小间距互通立交区交通冲突率较高、驾驶负荷较重等问题，本文从道路因素、交通流因素以及驾驶员视觉特性入手，提出了基于微观仿真交通冲突分析技术和驾驶模拟视觉特性分析技术的交通安全评价方法。并以深外环高速公路典型的小间距互通群为实例，通过仿真场景构建、交通冲突分析、驾驶模拟试验等进行交通安全性评价。最后，以“快进缓出”为设计理念，针对性的提出了小间距互通立交区组合式标志标线设置方法，旨在提升交通标志的视认性，减轻驾驶员的驾驶负荷，实现互通立交交织区交通流有效诱导、快速分流。本研究可为高密度高负荷小间距互通区的安全评价、标志标线优化方法提供技术支撑。

关键词：小间距互通；安全评价；冲突率；视觉特性分析；标志标线优化

Safety Evaluation Method of Small Spacing Interchange Under High-Density and Heavy Traffic Flow and Improvement Measures

Xu Tian, Deng Hanyue, LUO Zhongbin, MA Xiaolong
(中交第一公路勘察设计研究院有限公司)

Abstract:

Abstract: In order to study the safety of high-density, high-load and small-pitch intercommunication zones, considering the road factor、traffic flow、and the driver visual characteristic, this paper proposes a safety evaluation method based on microscopic simulation traffic conflict analysis technology and driving simulation visual analysis technology to solve the problem of traffic conflict, the driver's visual load and the rationality of the flag setting. The feasibility and effectiveness of the above method is verified by using the Shenwaihuan Highway typical road sections as an example. Finally, with the concept of “fast-forward and slow-out”, a new method of setting the combination road traffic signs and marking for small-pitch interchange is proposed. This study can provide technical support for the safety evaluation and marking line optimization method of high-density, high-load and small-pitch intercommunication zones.

keywords: small-pitch intercommunication; safety evaluation; conflict rate; visual characteristic analysis; road traffic signs and markings optimization

作者简介：许甜，中交第一公路勘察设计研究院有限公司，77459997@qq.com。

智能网联车环境下异质交通流稳定性及安全性分析

胡蓉，姚志洪，赵斌，王逸，蒋阳升
（西南交通大学）

摘 要：随着智能网联车的发展，道路上行驶的车辆将会由人工驾驶车辆向智能网联车辆逐渐过渡，因此研究智能网联车环境下的异质交通流稳定性与安全性对于保证道路交通安全具有重要的意义。为了准确地描述未来道路上异质交通流中车辆的跟驰特性，首先采用全速度差（FVD）和智能驾驶员模型（IDM）分别描述人工驾驶车辆和智能网联车辆。然后，分析了异质交通流的线性稳定性，得出了智能网联车不同渗透率下异质交通流的稳定性条件。最后，设计了数值仿真实验，并选取车速标准差、碰撞时间 TET、TIT 与追尾碰撞风险指数（TERCRI）等四项指标对不同渗透率下异质交通流的安全性进行了评估。结果表明：随着智能网联车辆渗透率的增加，异质交通流的车速离散程度减小，即表示系统越安全；TET、TIT 与 TERCRI 指标降低比例随渗透率的增加而减少，即车辆的追尾碰撞时间和风险指数降低。因此，智能网联车的应用有助于提高道路交通安全。

关键词：智能网联车；稳定性；安全性；跟驰模型；异质交通流

Analysis of Stability and Safety for Heterogeneous Traffic Flow in Connected Automated Vehicles Environment

Hu Rong, Yao Zhihong, Zhao Bin, Wang Yi, Jiang Yangsheng
(Southwest Jiaotong University)

Abstract:

With the development of connected automated vehicles (CAVs) technologies, the vehicles on the road will gradually transition from human-driven vehicles (HDVs) to CAVs. Therefore, it is of great significance to study the stability and safety for heterogeneous traffic flow in connected automated vehicles environment to ensure road traffic safety. In order to accurately capture the car's car-following characteristics for heterogeneous traffic flow on the road in the future, firstly, the full speed difference (FVD) and the intelligent driver following model (IDM) were used to describe the HDVs and CAVs. Then, the stability conditions of heterogeneous traffic flow under different penetration rate of the CAVs were obtained by analyzing the linear stability. Finally, a numerical simulation experiment of heterogeneous traffic flow was designed, and the safety of heterogeneous traffic flow under different penetration rate was evaluated by four criteria: vehicle speed standard deviation, collision time TET, TIT and rear-end collision risk index (TERCRI). The results show that the dispersion of the speed of the heterogeneous traffic flow is reduced by the increase of the penetration rate of CAVs, which means that the system is safer. The reduction ratio of TET, TIT and TERCRI indicators are decreased with the increase of penetration rate, which indicate the collision time and risk index of vehicles are reduced. Therefore, the application of CAVs is able to improve road traffic safety.

keywords: connected automated vehicles; stability; safety; car-following model; heterogeneous traffic flow

作者简介:胡蓉，西南交通大学，18782189426@163.com。

The Impact of Transportation Infrastructure and Whole Region's Urbanization on Economic Development

LI Yue
长江大学

Abstract: This study aims to evaluate the economy impact of transportation infrastructure and whole-region's urbanization from the perspective of new economic geography, a spatial panel model was constructed based on the panel data of transportation infrastructure, urbanization and economic development in 30 provinces and municipalities in China from 1997 to 2016. In this model, time-lag effects and spatial-lag effects were considered. The results show, in underdeveloped areas, transportation infrastructure, living environment, and medical and health conditions have a significant role in promoting economic development. In developed areas where transportation infrastructure has been essentially mature, the direct or indirect effect of transportation infrastructure on economic development is insignificant; however, the living environment, medical and sanitary conditions, and residents' housing level still have a significant role in promoting economic development.

Key words : Economic Development; Transportation infrastructure; Whole-region's urbanization; Spatial panel model

Analysis of Bus Drivers' Crashes, Violation and Risk Driving Behaviors

Li Ruirui (China)
同济大学
ruiruili@tongji.edu.cn

Wang Xuesong (China)
同济大学
wangxs@tongji.edu.cn

Abstract: As the importance of the public transportation and its usage increases, bus safety draws more attention. Safety education is a major countermeasure to improve bus drivers' safety awareness and driving behavior. Current safety education treats all bus drivers in the same way and it neglects the difference needs in behavior improvements between drivers. In order to better implement bus driver safety education and behavior intervention, this paper analyzes bus drivers' crashes, violations and risk driving behavior. The data this study used were extracted from police database for a bus company, including drivers' naturalistic driving video, personal characteristics, violation and crash records. The naturalistic driving video was used to analysed drivers' risk driving behaviour; the crash and violation data were used to analyse the characteristics of bus drivers' violation and crash. An ordered logit model was employed to develop the effect of personal characteristics and violations on crash occurrence. Key results show that 1) the most common risk driving behaviour among bus drivers is parking violation at bus stop; 2) 16.4% of all drivers are involved in 57.2% of the crashes; 3) drivers with the increase in violations tends to be more crash-prone; 4) male bus drivers and drivers with less than 11 years driving experience are more likely involved in crashes. The results of this study can provide guidance for bus drivers' safety education and behavior intervention.

Key words: Bus Driver; Traffic Crashes; Traffic Violations; Risk Driving Behavior; Logit regression

The Safe System Approach: Accommodating Human Error

Qumar-Ul Zaman Bhatti (Pakistan)
South East University China
223175736@seu.edu.cn

Abstract: While using the road, the amount of risk is directly correlated to the amount of exposure in the road network system. Safety and accident issues are considered as an important problem in the world. Therefore, analysis of data is an important tool to make decisions. Reliability estimates of the road traffic injuries in comparison with other issues play critical role in advocating the prioritization of road safety in current era for developing road safety strategies, setting achievable safety targets and of course monitoring progress of the safety paradigm.

Key words: Road safety, crashes, injury, fatigue, hyper parameter, neural networks

基于可拓云模型的城市道路交通安全评价方法研究

韩刚，齐远，杨宇星
（深圳市城市交通规划设计研究中心有限公司）

摘 要：近年来，随着城市道路交通安全的关注度越来越高，如何预防和减少交通事故、提高城市道路交通安全水平成为研究重点。本文从城市道路交通安全影响因素分析着手，从“道路工程”、“交通运行状态”、“人与环境”三个大方面构建城市道路交通安全评价指标体系，对物元可拓法和云模型进行了介绍，利用两者的优势构建基于可拓云模型的城市道路交通安全评价方法，利用可拓云模型对三条道路的安全水平进行评价，并根据评价结果为道路交通安全改善提供针对性的改善策略。结果表明基于可拓云模型的城市道路交通安全评价方法适用于城市道路交通安全评价，能够有效反映出实际问题中的模糊性和随机性。该方法在道路危险因素的及时发现以及提高交通安全水平方面有积极的作用。

关键词：交通安全；可拓云模型；评价指标；可信度

Research on the Urban Road Traffic Safety Evaluation Method Based on Extension Cloud Model

Han Gang, Qi Yuan, Yang Yuxing
(Shenzhen Urban Transport Planning Center)

Abstract:

In recent years, with the increasing attention of urban road traffic safety, how to prevent and reduce traffic accidents and improve the safety level of urban road traffic has become the focus of research. This paper first analyzes the factor’s affecting of traffic safety, from the "road engineering" , "traffic operation status", "human and environment" three aspects to establish road traffic safety evaluation index system, and introduce the matter-element extension method and cloud model, use the advantages of both to build a road traffic safety evaluation method based on the extension cloud model. The extension cloud model is used to evaluate the safety level of the three roads, and according to the evaluation results, targeted improvement strategies are provided for road traffic safety improvement. The research in this paper shows that the urban road traffic safety evaluation method based on the extension cloud model is suitable for urban road traffic safety evaluation and this method can effectively reflect the ambiguity and randomness in practical problems. This method has a positive effect in found risk factors of road traffic safety in time and improve the road traffic safety level.

keywords: traffic safety; the extension cloud model; evaluation index; reliability

作者简介:韩刚，深圳市城市交通规划设计研究中心有限公司 ，879508817@qq. com。

山区高速公路隧道——互通路段安全评价

尚婷，盛启锦，白婧荣
（重庆交通大学）

摘 要：为了识别山区高速公路隧道-互通路段行车风险，提出了基于熵权物元的安全评价模型。首先选取隧道段、互通段以及连接段等 3 个方面的 9 个因素作为评价指标，这 9 个因素与行车速度直接相关，构建隧道-互通路段的评价指标体系；引入可拓学的理论，采用熵权确定各因素的指标权重；最后，通过某高速公路实测数据进行案例结算。结果表明，该路段的安全性为“轻度危险”且更偏向于“安全边缘”一侧，并可以确定各指标对待评路段的安全性影响等级，可以进行相应的改善措施提高行车安全性。

关键词：交通工程；隧道-互通路段；安全评价；熵权物元模型

Safety Evaluation of Mountain Highway Tunnel-Inter-Channel Section

Shang Ting, Sheng Qijin, Bai Jingrong
(Chongqing Jiaotong University)

Abstract:

In order to identify the traffic risk of mountain highway tunnel-intersection section, a safety evaluation model based on entropy weight element is proposed. Firstly, nine factors including three aspects: tunnel section, intercommunication section and connection section are selected as evaluation indicators. These nine factors are directly related to driving speed, and the evaluation index system of tunnel-inter-channel section is constructed. The theory of extenics is introduced. The entropy weight determines the index weight of each factor; finally, the case settlement is carried out through the measured data of a certain highway. The results show that the safety of the road section is “mild danger” and is more biased towards the “safety edge” side, and the safety impact level of each indicator to be evaluated can be determined, and corresponding improvement measures can be implemented to improve driving safety.

keywords: traffic engineering; tunnel-intersection section; traffic safety; entropy weight matter element model

作者简介:尚婷，重庆交通大学，335304854@qq. com。

高速公路单向外侧车道封闭施工区基于交通冲突的交通安全评价方法综述

王建军，刘博蓉
（长安大学）

摘 要：分析交通冲突技术国内外研究现状，从交通冲突技术的概念出发，分别阐述高速公路单向外侧车道封闭施工区交通冲突产生机理、施工区交通冲突类型，交通冲突风险评价指标，总结了基于交通冲突术的高速公路单向外侧车道封闭施工区交通安全评价方法及每种方法的局限性，最后为基于交通冲突技术的施工区交通安全评价方法的发展提供一些浅见。

关键词：安全评价；交通冲突；高速公路施工区

Traffic Safety Assessment Method of Freeway Workzone with Unidirectional Outside Lane Closed Based on the Traffic Confflicts

Wang Jianjun, Liu Borong
(Chang'an University)

Abstract:
Analyze current situation of traffic conflict at home and abroad,based on the conception of traffic conflict , the essay expounds the generating machanism of traffic conflict,the conflict type ,the evaluation index and summarize traffic safety assessment methods of freeway workzone based on the traffic conflict .Finally sugesstions about the traffic safety assessment method of freeway workzone were given.
keywords: risk assessment; traffic conflict; freeway workzone

作者简介:王建军，长安大学，wjjun16@163.com。

一起高速公路桥梁伸缩装置失效事故成因分析

何治剑，张诗波
（西华大学汽车与交通学院）

摘 要：为对涉及桥梁伸缩装置失效的交通事故的成因鉴定提供借鉴作用，以一起发生在京昆高速四川段某桥梁上的DX-160型模数式伸缩装置失效事故为例，对失效伸缩装置的构造、损坏状况、材料性能、焊接质量、安装质量等方面进行了实地检验、金相分析和拉伸试验，并在分析该装置工作原理的基础上，利用物理学原理对中梁与横梁焊接的失效、位移箱支座的失效以及中梁型钢的断裂失效进行了分析，最终锁定该伸缩装置失效的成因。结果表明：桥梁伸缩装置部分位移箱预留槽的混凝土在浇筑施工时未完全填充捣实，以致在频繁的交变载荷下，部分位移箱底板开裂，造成部分位移箱内的支座脱落以及部分横梁和中梁的焊缝断裂，从而改变了中梁型钢承受车辆行驶载荷的传递方式，进而中梁型钢在交变集中载荷作用位置形成应力集中，最终导致中梁型钢在该处发生疲劳断裂失效。

关键词：道路工程；桥梁伸缩装置；成因鉴定；伸缩缝病害

Failure Accident Mechanism of a Bridge Expansion Joint on an Expressway

He Zhijian, Zhang Shibo
(西华大学汽车与交通学院)

Abstract:

In order to provide reference for the identification of traffic accidents involving failure of bridge expansionjoint, a case accident failure of DX-160 modular expansion joint on a bridge of Beijing-Kunming Expressway (Sichuan section) is taken as an example. Field investigation, metallographic analysis and tensile test were carried out in terms of damage condition, material properties, welding quality and installation quality. Based on analysis for the working principle of the device and some principles of physics, the failure of the welding between the middle beam and the crossbeam, the failure of the displacement box supports and the fracture failure of the middle beam steel were analyzed, and finally the cause of the failure of the expansion joint was locked. The results show that the concrete reserved for the displacement box of the bridge expansion joint is not completely filled with concrete during the pouring construction, so that under the frequent alternating load, the bottom plate of some displacement boxes is cracked, causing the supports in some displacement boxs to fall off ,meanwhile, the weld seam between the crossbeam and the middle beam is broken, which changes the transmission mode of the middle beam steel to the driving load of the vehicle, and the middle beam steel forms stress concentration at the position of the alternating concentrated load, which eventually leads to fatigue fracture failure of the middle beam steel.

keywords: road engineering; bridge expansion joint; cause analysis; expansion joint hazard

作者简介:何治剑，西华大学汽车与交通学院， hzj20190125my@outlook.com。

山区高速高桥隧比路段事故率模型构建

尚婷，白婧荣，盛启锦，田诗涵
（重庆交通大学；重庆交通大学；重庆交通大学；重庆市市政设计研究院）

摘 要：为分析影响山区高速高桥隧比路段交通安全的主要影响因素及其对事故率的影响规律，本文从道路线形和路面抗滑能力等方面对高桥隧比路段事故率进行分析，根据路段划分原则，建立四种不同路段的事故率预测模型，分别为隧道入口曲线路段、隧道入口直线路段、隧道出口曲线路段、隧道出口直线路段。对不同类型路段选择相应的路段数据和自变量，通过多元线性回归，构建事故率预测模型。结果表明：在线形条件最差的情况下，路面横向力系数 SFC 需求值远大于规范规定值，隧道入口直线路段所需求的路面抗滑性能最高，隧道出口曲线路段所需求的路面抗滑性能最低，其原因是因为直线路段比曲线路段线形条件更好，导致行车速度更快，故路面抗滑性能需求也更高。

关键词：山区高速公路；高桥隧比；事故率；模型构建

Construction of Accident Rate Model for High-Crossing Sections of Highway Bridge in Mountainous Areas

Shang Ting, Bai Jingrong, Sheng Qjin, Tian Shihan
(Chongqing Jiaotong University; Chongqing Jiaotong University; Chongqing Jiaotong University; 重庆市市政设计研究院)

Abstract:

The main influential factors affecting the traffic safety of high-crossing sections of highway bridge in mountainous areas and their effect on the accident rate are analyzed, this paper analyzes the accident rate of the high-crossing sections of highway bridge from the aspect of the road alignment and the anti-sliding ability of the road surface, According to the principle of the road sections, the accident rate prediction models for four different sections are established, which are the curve section of the tunnel entrance, the straight section of the tunnel entrance, the curve section of the tunnel exit, and the straight section of the tunnel exit. For different types of road sections, the corresponding road data and independent variables are selected, multiple linear regression is performed by spss software, and an accident rate prediction model is constructed. The results show that under the worst condition of linear condition, the demand value of SFC lateral force coefficient is much larger than the specified value, the required anti-sliding performance of the road surface is the highest for the tunnel entrance straight section, and the anti-sliding performance of the road surface required for the tunnel exit curve section is the lowest. The reason for this is that the direct line segment is better than the curve line segment condition, resulting in faster driving speed, and therefore the demand for anti-sliding performance of the road surface is also higher.

keywords: mountain expressway; high-crossing highway bridge tunnel ratio; accident rate; model construction

作者简介：尚婷，重庆交通大学，335304854@qq.com。

公路曲线段视错觉减速标线设置方法

尚婷，唐伯明，白婧荣，盛启锦
（重庆交通大学）

摘 要：为研究公路曲线段视错觉减速标线对驾驶员眼动指标的影响，应用 3D-MAX 和 UC-win/Road 对不同参数的视错觉减速标线进行仿真模拟；采用 SMI2.1 眼镜式眼动仪记录了 25 名被测试者的眼动数据，分析了在设计速度为 60km/h 的公路曲线段，视错觉减速标线对驾驶员眼动指标的影响，并通过主成分分析和 85 位法，建立了驾驶员在不同转弯半径下的视觉负荷模型及其阈值。结果表明：视错觉减速标线的横向宽度为 40cm，角度为 90°；当转弯半径为 125m、200m、300m 和 600m 时，标线间距为 6m；当半径为 400m 和 500m 时，标线间距为 4m 和 6m；当半径介于 700m-1000m 时，间距呈逐渐减小的方式布置。

关键词：交通安全；眼动特征；公路曲线段；视错觉减速标线

Research on the Visual Illusion Speed Deceleration Marking of Road Curve

Shang Ting, Tang Boming, Bai Jingrong, Sheng Qijin
(Chongqing Jiaotong University)

Abstract:

Different parameters of visual illusion speed deceleration marking have been simulated using the 3D-MAX and UC-win/Road to study the effect of highway curve section visual illusion speed deceleration marking on the eye movement of drivers. The data of 25 drivers` eye movement have been recorded with SMI2.1 Eyeglass type eye tracker. The impact of visual illusion speed deceleration marking on drivers` eye movement under highway curve section on the vehicle with a design speed of 60km/h was analyzed. Through the principal component analysis and the 85-bit method, the driver's visual load under different turning radius and its threshold was calculated. The results show that the compressed lane of the illusion deceleration speed line is 40cm and the angle is 90°, the spacing is 6m when the radius is 125,200,300 and 600m. When the radius of 400 and 500m, the visual illusion speed control line is arranged equidistantly and the spacing value is 4m and 6m. When the radius of 700m <R <1000m, the line spacing and straight line segment, was gradually decreasing the way the layout is better.

keywords: traffic Safety; visual characteristic; road curve; visual illusion speed deceleration marking

作者简介:尚婷，重庆交通大学，335304854@qq.com。

Research on Traffic Congestion of Urban Main Road Under Accident Conditions

Wang Jianjun, Sun Jiaxin
Chang'an University
wjjun16@163.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, road network operation efficiency reduction, and adverse losses to the social economy. For traffic accidents on urban complex road networks, it is urgent to solve the urban traffic problems such as dredging and disaster reduction, reducing the impact of the road network and maintaining the smooth and orderly operation of the road network traffic flow. To solve the problems, it is necessary to have a clear understanding and evaluation of 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.

Key words: traffic congestion situation; congestion impact range; accident conditions

高海拔地区雾天环境下高速公路限速模型优化研究

赵建有，姚景轩，郭万江，贾浩楠
（长安大学；长安大学 汽车学院；长安大学；长安大学）

摘 要：随着中国经济的发展，中国高速公路总里程和汽车保有量的不断增加，因雾天引发的高速公路交通事故数量也在不断上升。雾天不仅影响了高速公路的安全行车，还成为了影响人们出行和社会生产的重要因素。本文以云南高原交通事故数据为依据，分析云南高原地区雾天安全行车的影响因素，并通过层次分析法判断影响高原雾天行车安全的因素比重。结合国内外的限速模型研究，根据能见度、路面摩擦系数、视距等因素建立以运动学原理为基础的修正限速模型，可得出高原地区不同能见度下的不同附着系数的限速值，再与其它模型进行比较，判断基于运动学原理的修正限速模型是否合理。同时对高原雾天安全行车的影响因素进行分析，从而得到优化的修正限速模型。

关键词：修正限速模型

Research on Speed Limit Model Optimization of Expressway in High Altitude Area

Zhao Jianyou, Yao Jingxuan, Guo Wanjiang, Jia Haonan
(Chang'an University)

Abstract:

With the development of China's economy, the total mileage of highways and the number of car ownership in China continue to increase, and the number of highway traffic accidents caused by foggy days is also rising. The foggy days not only affected the safe driving of the expressway, but also became an important factor affecting people's travel and social production. Based on the traffic accident data of Yunnan Plateau, this paper analyzes the influencing factors of safe driving in foggy areas in Yunnan Plateau, and judges the proportion of factors affecting the safety of foggy weather in the plateau through analytic hierarchy process. Combined with the research of speed limit model at home and abroad, based on the visibility, road friction coefficient, line of sight and other factors to establish a modified speed limit model based on the kinematics principle, the speed limit values of different adhesion coefficients under different visibility in the plateau can be obtained. Then compare with other models to judge whether the modified speed limit model based on kinematics is reasonable. At the same time, the influencing factors of safe driving on the plateau foggy day are analyzed, and the optimized modified speed limit model is obtained.

keywords: revised speed limit mode

作者简介：赵建有，长安大学，jyzhao@chd. edu. cn。

基于随机森林的行人事故严重程度预测研究

朱林艳，韩刚
（武汉市规划研究院 深圳市城市交通规划设计研究中心有限公司）

摘 要：近年来，由于道路交通拥挤、行人不遵守交通规则等原因，行人交通安全问题十分突出，行人交通事故频发，行人交通安全的研究刻不容缓。本文构建基于随机森林的行人受伤严重程度预测分类模型，并以H市行人交通事故数据为基础进行事故严重程度分类预测，与经典模型准确率进行对比分析。最后，对行人交通事故的特征变量重要性进行排序，得出重要特征变量与行人受伤严重程度的关系，有利于降低事故伤亡，为后续合理安全的交通设计和良好的交通管理提供参考依据。

关键词：行人交通事故；随机森林；伤害预测；特征分析；分类模型

Study on Pedestrian Accident Severity Prediction Based on Random Forest

Zhu Linyan, Han Gang
(武汉市规划研究院　Shenzhen Urban Transport Planning Center)

Abstract:

In recent years, traffic congestion and many pedestrians disobey rules makes the pedestrian safety a really noticeable problem, the pedestrian traffic safety research is urgently needed. In this paper, the basic theory of pedestrian traffic accident is introduced. Based on the random forest model, a new predictive classification model in pedestrian injury severity is proposed, and based on the data of pedestrian traffic accidents in H city, the classification of accident severity is predicted and compared with the accuracy of classical models. Finally, the importance of the pedestrian characteristic variables is sorted, and figure out the relationships between them and the pedestrian accident severity, which is beneficial to reduce casualties and provide reference for reasonable and safe traffic design and good traffic management.

keywords: Pedestrian traffic accident; Random forest; Traffic injury prediction; Characteristic analysis; Classification model

作者简介:朱林艳，武汉市规划研究院，1171719148@qq.com。

基于多项 Logit 模型的山区高速公路追尾事故严重程度分析

李贵，阳兰天
（长安大学 深圳前海云创交通科技服务有限公司）

摘 要：为了分析山区高速公路追尾事故，收集了 2012 年-2017 年江西省昌金高速公路以及泰赣高速公路的 948 条追尾事故数据。考虑应用多项 Logit 模型对事故数据进行了处理。首先，依靠数据对多项 Logit 模型假定条件进行了验证，验证通过进而对模型参数进行了估计。最终，量化了不同影响因素对追尾事故严重程度的影响大小。结果表明，收集到的 13 个潜在影响因素中，驾驶员性别、年龄、涉及货车、冒险跟随、竖曲线类型、事故时间均影响受伤事故或死亡事故发生。此外，圆曲线半径、星期、季节影响受伤事故发生，超速、坡度、天气、疲劳驾驶影响死亡事故发生。综上述，本文研究结果有助于决策者了解哪些风险因素影响事故严重发生，这为改善山区高速公路行车环境提供了思路。

关键词：山区高速公路；追尾事故；多项 Logit 模型

The Severity Analysis of Expressway Rear-End Collision Accident in Mountainous Area Based on Multinomial Logit Model

Li Gui, Yang Lantian
(Chang'an University 深圳前海云创交通科技服务有限公司)

Abstract:

In order to analyze the rear-end accident of expressway in mountainous area,948 rear-end accident data of changjin expressway in mountainous area of jiangxi province were selected for research.Consider applying multinominal logit model to process the incident data.Firstly,the assumptions of multinominal logit model was verified,then the parameters of the model were estimated based on the data,quantified the impact of different factors on the severity of the rear-end collision. The results showed that among the 13 potential influencing factors collected.Driver gender, age, involved truck, risk following, vertical curve type and accident time all affect the occurrence of injury or death accidents.In addition, the radius of circle curve,season and week affect injury accidents,and speeding,slope and weather affect death accidents.To sum up,the research results are helpful for decision makers to understand which risk factors affect the severity of accidents,and then put forward safety countermeasures to reduce the severity of expressway rear-end collision in mountainous areas.dge management.

keywords: mountain area expressway; Rear-end collision; multinomial logit model

作者简介:李贵阳，长安大学，962481509@qq. com。

运用改进累计频率法的事故多发段鉴别分析

李荀，卢欢欢
（长安大学）

摘 要：本文对河南某高速公路事故数据进行分析，结合高速公路事故特点及数据采集地具体情况，运用改进后的累计频率曲线法确定了研究路段的事故多发段，有效地解决了鉴别过程中的路段划分难和事故严重程度并入难等问题。找出事故发生的主要原因，提出相应的排查整治措施，为高速公路设计与安全设施布设等提供理论参考依据，有助于降低交通事故率，对改善我国高速公路的整体交通安全状况也有着十分重要的现实意义。

关键词：累计频率法；高速公路；交通事故；鉴别

Analysis of the Identification of Accident-Prone Section Based on Improved Cumulative Frequency Method

Li Xun, Lu Huanhuan
(Chang'an University)

Abstract:

In this study, the accident data of a certain expressway in Henan province and the specific situation of the data collection area was analyzed, and the improved cumulative frequency curve method is used to determine the accident blackspot of the studied section, which effectively solves the problems such as the difficulty of section division and incorporating the accident severity. Then put forward the corresponding investigation and renovation measures through the main cause of the accident. Findings of this paper can provide advisory opinion for the design of highway and safety facilities layout, reduce the traffic accident rate, also have an important practical significance for improve the traffic safety situation of China's highway.

keywords: Cumulative frequency method; Freeway; Traffic accident; Identify

作者简介:李荀，长安大学，809449230@qq. com。

Examining Drivers Injury Severity of Two-Vehicle Crashes Between Passenger Cars and Light Motor Trucks

Yang Jia (Japan)
Toyota Transportation Research Institute
yang@ttri.or.jp

Ren Peng (China)
交通部科学研究院
re_peng@163.com

Ryosuke Ando (Japan)
Toyota Transportation Research Institute
ando@ttri.or.jp

Abstract: This study aims to investigate the important factors affecting the drivers` injury severity of two-vehicle crashes between passenger cars (PCRs) and light motor trucks (LMTRs). To consider the difference between elder drivers and non-elder drivers, 889 vehicle crash data for elder LMTR drivers and 4,690 vehicle crash data for non-elder LMTR drivers in Fukuoka Prefecture, Japan is used as the research sample. The injury severity of PCRs with LMTRs for elder drivers and that for non-elder drivers are modeled by two bivariate ordered probit models, respectively. Each ordered probit model in a bivariate ordered probit model is used to measure the injury severity of one driver, and the covariance measures the correlation of injury severity. The major findings suggest: 1) that weather condition, traffic condition, manner of collision have different effects for injury severity of LMTR drivers in two types of crashes; 2) that time of day and road level do not have any effects for injury severity of LMTR drivers in two types of crashes; 3) that the injury severity of two drivers involved in two types of crashes are negatively correlated, since two crash patterns i.e. no injury with minor injury and minor injury with no injury accounted for large ratios inside two types of crashes, which indicated that there is only one driver injured in most crashes of PCRs with LMTRs.

Key words: Two-Vehicle Crash, Light Motor Truck, Bivariate Ordered Probit Model, Gibbs Sampler Algorithm

货车交通事故严重程度影响因素分析

马倩楠，张生瑞
（长安大学）

摘 要：为了准确分析货运车辆交通事故严重程度的影响因素，合理规避不利因素对货车交通安全的影响。对英国 2015-2016 年交通事故数据中车辆、道路环境、交通条件三个客观因素中的 13 个变量共计 370 个样本进行分析。建立 Ordinal Logistic 模型，并对模型进行了平行线检验（p=0.1028，df=7）、似然比检验（p<0.0001，df=7）。检验结果表明建立的模型符合检验要求。接着对模型进行了数据库数据检验，准确率达 87%。结果表明，车辆载重、车辆拖挂和事故发生时的特殊条件对货车交通事故严重程度有显著影响，建立的 Ordinal Logistic 回归模型在事故严重程度影响因素分析具有良好的实用性和适用性。

关键词：交通安全；Ordinal Logistic 模型；事故影响因素；货运车辆

Analysis of Factors Affecting the Severity of Traffic Accidents

Ma Qiannan, Zhang Shengrui
(Chang'an University)

Abstract:

In order to accurately analyze the influencing factors of the seriousness of traffic accidents of freight vehicles, reasonable influences on the traffic safety of trucks are avoided. A total of 370 samples from 13 objective variables of vehicle, road environment and traffic conditions in the UK 2015-2016 traffic accident data were analyzed. The Ordinal Logistic model was established and the model was tested by parallel line (p=0.1028, df=6) and likelihood ratio test (p<0.0001, df=6). The test results show that the established model meets the inspection requirements. Then the database data was tested on the model, and the accuracy rate was 87%. The results show that the special conditions of vehicle load, vehicle towing and accident have a significant impact on the severity of truck traffic accidents. The established Ordinal Logistic regression model has good practicability and adaptability in the analysis of the factors affecting the severity of accidents.

keywords: Traffic safety; Ordinal Logistic model; Accident influencing factors; Freight vehicles

作者简介：马倩楠，长安大学，853673466@qq.com。

基于元胞自动机的混入逆行的非机动车交通特性研究

邵海鹏，陈思恬，李静娴，郑斌斌
（长安大学；长安大学 佛山市规划设计研究院；惠州市道路桥梁勘查设计院综合所）

摘 要：我国各大城市均有不同程度非机动车在单向非机动车道上逆向行驶的现象，在不同的道路断面条件下，逆向及正向行驶车辆遵循不同的换道规则。本文基于此，建立有无分隔带的混入逆行车流的元胞自动机模型，来研究逆行非机动车对正向行驶非机动车流的影响。仿真结果表明：在同等条件下，随着逆行比例的增加，非机动车交通流对应的单车道的流量和速度减少，到达单车道最大流量时对应的密度值也降低，若处于低密度阶段，则逆行车辆的比例就对速度、流量的影响较小。该模型能为在不同道路条件下提高非机动车道的通行能力提供依据。

关键词：交通工程；通行能力；元胞自动机；逆行非机动车；分隔带

Research on Non-Motorized Traffic Characteristics of Hybrid Retrograde Non-Motor Vehicles Based on Cellular Automaton

Shao Haipeng, Chen Sitian, Li Jingxian, Zheng Bingbing
(Chang'an University; Chang'an University; 佛山市规划设计研究院惠州市道路桥梁勘查设计院综合所)

Abstract:

The major cities in China have different degrees of non-motor vehicles driving reversely in one-way non-motorized lanes, reverse and forward vehicles follow different lane change rules in different road sections. Based on this, cellular automaton model with and without divided zones are established. The simulation results show that under the same conditions, with the increase of the proportion of reversely driving vehicles, non-motor vehicles' flow and speed of single lane reduce, the corresponding density value when reaching the maximum flow of single lane also decreases, in the low density phase, the ratio of retrograde vehicles has less impact on flow rate and speed. This model can provide the basis for improving the traffic capacity of non-motorized lanes under different road conditions.

keywords: traffic engineering; capacity; cellular automaton; retrograde vehicles; isolation

作者简介：邵海鹏，长安大学，shaohp@chd. edu. cn。

基于熵权云模型的交通事故路段行车风险评价

张文会，孙舒蕊
（东北林业大学）

摘 要：道路上发生初次事故后，由于驾车者对事故处置经验不足、事故检测设施缺乏、救援不及时等原因，“二次事故”易随之发生。本文通过对事故路段行车风险影响因素的辨识分析，构建交通事故路段行车风险评价指标体系，建立基于熵权法和云模型法的交通事故路段行车风险评价模型，旨在有效降低事故路段行车风险性。通过分析哈尔滨至大庆高速公路的实际案例，判断风险评价等级，并与其他方法对此路段的评价结果作对比，结果一致，验证了模型的实用性。该模型应用于实际案例中，得出评价结论，找到对事故路段行车风险影响较大的一级、二级评价指标，为道路使用者和道路管理人员提供了科学合理的指导建议，以期减少二次交通事故的发生。

关键词：交通工程；事故路段；风险评价；熵权法；云模型法；二次事故

Traffic Risk Assessment of Traffic Accident Sections Based on Entropy Weight Cloud Model

Zhang Wenhui, Sun Shurui
(Northeast Forestry University)

Abstract:

After the first accident on the road, the "secondary accident" is easy to happen due to the driver's lack of experience in handling the accident, lack of accident detection facilities, and untimely rescue. Based on the identification and analysis of the influencing factors of traffic risk in the accident section, this paper constructs a traffic risk evaluation index system and a traffic risk evaluation model based on entropy weight method and cloud model method in order to effectively reduce the traffic risk in the accident section. Through the analysis of the actual case of Harbin - Daqing Expressway, the risk evaluation grade is judged and compared with the evaluation results of this section by other methods, the results are consistent, and the practicability of the model is verified. This model is applied to practical cases to draw the evaluation conclusion, find the first and second evaluation indexes that have great influence on the traffic risk of the accident road section, and provide scientific and reasonable guidance suggestions for road users and road management personnel in order to reduce the occurrence of secondary traffic accidents.

keywords: traffic engineering; accident section; risk assessment; entropy weight method; cloud model method; secondary accident

作者简介:张文会，东北林业大学，zhangwenhui@nefu.edu.cn。

改扩建公路中分带开口交通仿真及安全性评价

杜子君，侯伟，吕能超，刘兆新，王旭
（武汉理工大学；武汉理工大学）

摘 要：为了降低单侧拼宽改扩建高速公路老路中央分隔带开口处行车风险，以老路中央分隔带开口长度及主线流量为自变量，对行车安全进行了量化分析。基于 VISSIM 微观仿真软件建立了典型的仿真场景，使用 SSAM 交通安全评估模型，分析不同开口长度及主线流量下的车辆速度、车辆换道点的位置、冲突数量、冲突严重程度以及冲突点的等指标，量化评价不同中央分隔带开口长度以及流量对安全性的影响规律，以此得到合理的中央分隔带的开口长度。研究结果表明，流量对冲突次数有显著影响，而开口段长度对于冲突的严重程度有显著影响，冲突点分布的位置均集中在开口段前 400m。研究结果对中央分隔带开口长度以及交通标志的设置能够提供理论依据。

关键词：中央分隔带；高速公路；单侧拼宽；安全评价；冲突；轨迹

Traffic Simulation and Safety Evaluation on Central Separation Opening of Reconstructed Freeway

Du Zijun, Hou Wei, Lv Nengchao, Liu Zhaoxin, Wang Xu
(Wuhan University of Technology; Wuhan University of Technology)

Abstract:

In order to reduce the risk of driving at the opening of the central divider of the old road in the old side of the highway, the driving safety of the old road is divided into the opening length and the main line flow as independent variables. Based on the VISSIM micro-simulation software, a typical simulation scenario is established. The vehicle speed, the position of the vehicle's change point, the number of conflicts, the severity of the conflict, and the conflict points are analyzed by the SSAM traffic safety assessment model. The influence of the opening length of different central dividers and the influence of flow on safety is quantitatively evaluated, so as to obtain a reasonable opening length of the central separation zone. The research results show that the flow has a greater impact on the number of collisions, and the length of the open section has a significant impact on the severity of the conflict. The location of the conflict points is concentrated in front of the open section 400m. The results of the study provide a theoretical basis for the opening length of the central divider and the setting of traffic signs.

keywords: central separation; freeway; single side widening; safety evaluation; conflict; trajectory

作者简介：杜子君，武汉理工大学，906038901@qq. com。

基于改进多重对应分析方法的事故成因关联挖掘

寇思元，王晨，宋燕超
（东南大学）

摘 要：为了响应我国“平安交通”发展战略，提升交通安全管理水平，本文提出一种基于改进多重对应分析的事故成因关联挖掘方法。以江苏省某百强县级市为对象，研究首先通过多重对应分析方法将与事故相关的人-车-路-环境变量信息统一到相同坐标系；接着使用局部线性嵌入LLE对信息进行非线性降维，保留事故变量间的复杂关系信息；最后基于K-means算法对事故变量进行聚类，发现具有重要关联性的事故成因。主要发现包括：(1)危险驾驶行为在特定环境交互作用下容易诱发交通事故，如城市次干路上的违法变道行为、城市快速路上的安全车距不足、三级无控制公路上的不让行行为、城市支路上的违法倒车行为；(2)特定驾驶人群需要重点教育与监管，包括年轻驾驶者、卡车司机与中年客车司机的安全意识问题；(3)符合道路设计规范的道路依然可能存在交通安全隐患问题，如未设置隔离和机非混合车道的四级公路、照明不佳的二级公路、无交通控制的三级公路等。研究通过挖掘人-车-路-环境-事故间的复杂关联，为交通安全治理提供重要依据，促进我国道路交通安全状况的改善。

关键词：交通安全；事故成因；多重对应分析；LLE降维；K-means聚类

Explore Crash Contributing Factors and Their Relationships Based on an Improved Multiple Correspondence Analysis

Kou Siyuan, Wang Chen, Song Yanchao
(Southeast university)

Abstract:

In order to implement China's "safe traffic" policy, this paper proposes an improved multiple correspondence analysis method to explore the crash contributing factors and their intercorrelations. Three years' crash data from a city in Jiangsu province were utilized for the study. First, the multiple correspondence analysis was conducted to map the information of human characteristics, vehicle characteristics, roadway factors, environmental factors, crash types into the same Euclidean space. Then, a non-linear LLE method was applied to reduce dimensionality while keeping critical information. At last, K-means algorithm was used to cluster factors. Factors belong to the same cluster were considered as correlated. Some interesting results were found: 1. The combination of aberrant driving behavior and specific road environment induce crash occurrence, including illegal changing on urban minor arterial, driving on urban expressway with insufficient sight distance, right-of-way violation on three-class highway, illegal backing up on urban local roads; 2. Specific driving group needs to be educated or monitored, including drunk young drivers, truck drivers, and middle-aged bus drivers; 3. roadways conforming with the standards could also have high crash potential, including four-class highway without median and dedicated non-motorist lanes; two-class highway with poor light condition; three-class highway without traffic control treatments. In general, the method successfully explore crash contributing factors and their relationship. It could help

policy-makers and practitioners better understand crash factors and thus improve roadway safety in China.

keywords: Traffic safety; crash contributing factors; multiple correspondence analysis; locally linear embedding; K-means clustering

作者简介:寇思元，东南大学，ksy968@sina.com。

高速公路隧道曲线路段弯道错觉效应调控方法研究

杨理波，杜志刚，余昕宇，蒋锦港，倪玉丹
（武汉理工大学）

摘 要：山区高速公路隧道弯道路段存在空间环境单调，视距视区不良，参照信息缺乏等特点，驾驶员易产生弯道错觉效应，不利于驾驶员安全行车。因此探索一种有效的交通工程方法改善弯道错觉效应，提高驾驶员的曲率感知能力是隧道弯道安全运行的重大挑战。本文基于室内仿真实验，选取弯道错觉程度为评价指标，研究隧道不同弯道半径条件下，线形诱导标志与反光环对驾驶员弯道感知的影响规律。实验结果表明：（1）采用线形诱导标志的布设方法，驾驶员弯道错觉表现为曲线半径高估，且仅在半径（200-400m）条件下，具有较好的诱导效果，同时驾驶员的弯道错觉程度与弯道半径和线形诱导标志的个数均具有显著影响；（2）采用反光环的布设方法，驾驶员的弯道错觉程度与弯道半径之间不存在显著性影响，仅与反光环布设个数之间存在显著影响，且随着反光环布设个数的增多（4-6 个），会导致驾驶员产生高估曲率的错觉，不利于驾驶员安全行车；（3）在隧道弯道路段（200-1800m），采用 3 个可见反光环的布设方式时，弯道错觉程度均小于 5%，因此，采用 3 个可见反光环的方法更有利于提高驾驶员在小半径曲线隧道中的曲率感知能力。

关键词：交通工程；隧道曲线路段；反光环；弯道错觉效应

Research on a Control Method for Curve Illusion in Curve Road Section of Expressway Tunnels

Yang Libo, Du Zhigang, Yu Xinyu, Jiang Jingang, Ni Yudan
(Wuhan University of Technology)

Abstract:

Curve road section of expressway tunnels has limitations in space, viewing distance, and reference information. In such situations, a driver is susceptible to a curve illusion; this phenomenon is not conducive to safe driving. Therefore, exploring an effective traffic engineering method to improve the curve illusion and the driver's curvature perception is a major challenge for safe operations in tunnels. Based on an indoor simulation experiment, this paper selected the curve illusion degree as the evaluation indices and studied the influences of chevron alignment signs and reflective rings on a driver's curvature perception in different radius curved tunnels. The following results were obtained: (1) Using the method of chevron alignment signs, the curve illusion of the driver is represented by an overestimation of the curve radius. The use of chevron alignment signs has a good effect at only a radius of 200 m and 400 m. At the same time, the degree of curve illusion has a significant influence on the radius of the curve and the number of chevron alignment signs; (2) With the method of arranging the reflective rings, there is no significant influence between the curve illusion and the radius of the curve, and there is a significant influence between the curve illusion and the number of the reflective ring. With the increase in the number of reflective rings (4-6), the driver will have the illusion of overestimating the curvature, which is not conducive to the driver's safe driving; (3) In a curved section of the tunnel (200-1800m), when three visible reflective

rings are used, the degree of curve illusion is less than 5%. Therefore, the method of using three visible reflective rings is more conducive to improving a driver's curvature perception in a curved section of the tunnel.

keywords: Traffic engineering;Curve road section of expressway tunnel; reflective ring; Curve Illusion

作者简介:杨理波，武汉理工大学，Leeberyang@163.com。

基于监控视频数据的交通违法行为影响因素研究

刘华，张伟，付川云
（西南交通大学；四川省城乡规划设计研究院；西南交通大学交通运输与物流学院）

摘 要：为有效降低交通违法行为发生频率，以内蒙古自治区某市 2018 年 5 月-7 月内三个信号交叉口的监控视频违法数据为基础，利用主成分分析和因子分析方法，分别探究探寻车辆类型、车辆归属地、月份、星期、季度、时段、防护栏及违法地点，对未按规定导向车道行驶行为、逆向行驶行为、闯红灯及违反交通标线行为的不同影响。结果表明：车辆因素和时间因素分别显著影响未按规定导向车道行驶和违反交通标线行为，空间因素及交通设施是逆向行驶行为的主要影响因素，而时间因素和车辆因素对闯红灯行为影响较高；时间因素、交通设施、空间因素及车辆因素对交通违法行为的影响程度依次降低。这为遏制信号交叉口交通违法行为提供一定的理论依据。

关键词：道路交通安全；交通违法行为；影响因素；主成分分析；因子分析

Investigating Influence Factors of Traffic Violations Based on Surveillance Video Data

Liu Hua, Zhang Wei, Fu Chuanyun
(Southwest Jiaotong University; 四川省城乡规划设计研究院; Southwest Jiaotong University)

Abstract:

For the sake of reducing the frequency of traffic violations effectively, it is urgent to explore its influencing factors. Based on the surveillance video data of three signalized intersections in a city of Inner Mongolia Autonomous Region from May to July 2018, we used principal component analysis and factor analysis methods to explore the influence that the factors, such as vehicle type, vehicle ownership, month, week, quarter, time periods, fences and violation locations had on driving in the inaccurate oriented lane, reverse driving, red light violation and traffic markings violation. The results show that the vehicle and time periods factor significantly influence the driving in the inaccurate oriented lane and traffic markings violation, respectively; the main factors of the reverse driving are spatial factor and traffic facilities; furthermore, time periods and vehicle factor have higher influence on red light violation. At the same time, the influence degree of time periods, traffic facilities, spatial and vehicle factor on traffic violation behaviors decreases successively. The aforementioned findings provide a theoretical basis for containing traffic violations at signalized intersections.

keywords: road traffic safety; traffic violation; influence factors; principal component analysis; factor analysis

作者简介:刘华，西南交通大学，1065053159@qq.com。

基于综合指数模型的国家综合交通系统安全性评估与对策建议

杨鸣，陆化普，张玉环
（清华大学）

摘 要：本文从交通运行安全性、交通系统可靠性和交通军民融合度三个方面架构了“国家综合交通系统安全性”评价指数体系，确定了各指数的定义及内涵、计算方法和评价标准。并采用“AHP-模糊信息隶属度法”构建了能用于实证研究的评估模型，对我国当前综合交通系统安全水平及差距进行了量化分析。在此基础上，为实现交通安全强国发展目标提出了相对应的对策建议。

关键词：交通安全；评价指标；综合指数模型

Research on Evaluation of the National Transportation Safety and Counter Measures Based on Comprehensive Index Model

Yang Ming, Lu Huapu, Zhang Yuhuan
(Tsinghua University)

Abstract:

This paper establishes an evaluation index system for the national transportation safety from three aspects, including traffic operation safety, traffic system reliability and civil-military integration. The definition and connotation, calculation method and evaluation criteria of each index are determined. Meanwhile, The "AHP-fuzzy information membership degree method" is used to construct an evaluation model that can be used for empirical research. According to the result of the quantitative analysis, counter measures are proposed for our goal to building China into a country with highly secure transportation system.

keywords: transportation safety; evaluation index; comprehensive evaluation model

作者简介：杨鸣，清华大学，1293231336@qq.com。

城市水下隧道坡度错觉改善研究

倪玉丹，杜志刚，杨理波
（武汉理工大学交通学院）

摘 要：为了研究城市水下隧道变坡点附近坡度错觉形成机理和改善设计，利用 3dmax 仿真软件构建了 0、1%、2%、2.5%、3%、4%的 6 种不同坡度差的连续下坡路段研究了不同坡度差对变坡点坡度错觉的影响，并提出路面条纹和 led 灯带及组合形式的改善方案，实验结果表明：（1）城市水下隧道变坡点处坡度错觉与前后坡的坡度差有关，在连续下坡路段，前后坡差达到 2%时开始产生坡度错觉，前后坡差在 2.5%以上坡度错觉效应明显；（2）路面条纹和 LED 灯带都对坡度错觉具有一定改善效果，但其组合方案对于坡度错觉改善效果最优，可使后坡朝向准确性提升 26.67%，坡度错觉矫正 93.33%，反应时间缩短 7.113s。

关键词：城市水下隧道；坡度错觉；连续下坡；改善研究

Improvement Research on Slope Illusion of Urban Subaqueous Tunnel

Ni Yudan, Du Zhigang, Yang Libo
(Wuhan University of Technology)

Abstract:
In order to study the formation mechanism of slope illusion and the improvement strategies of urban underwater tunnel near the slope point, 3dmax simulation software is used to construct 6 slopes with different slope gaps（0， 1%, 2%, 2.5%, 3% and 4%）to study the impact of slope gaps on the slope illusion of the changing point. The pavement streaks and LED light strips and their combination is proposed to improve the slope illusion. The results show that: (1) the slope illusion at the changing point of urban subaqueous tunnel is related to the difference between the slopes. In the continuous downhill section, the slope illusion begins when the slope difference reaches 2%, and the slope illusion effect is obvious when the slope difference is more than 2.5%. (2) both pavement streaks and LED light strips can improve the slope illusion to a certain extent, but their combined scheme has the best improvement effect, which can improve the accuracy of the rear slope orientation by 26.67%, correct the slope illusion by 93.33%, and shorten the response time by 7.113s.
keywords: urban underwater tunnel; Slope illusion; Continuous downhill; improvement strategies

作者简介:倪玉丹，武汉理工大学交通学院，nininiif@163.com。

The Fatal Traffic Accident in Tunnel Portal: A Case Study and Perspective

Qiao Qingqing (China)
长安大学公路学院
1792276876@qq.com

Abstract: This Express Letter reported a fatal traffic accident on Xi'an-Hanzhong Expressway, Shaanxi Province, China, which occurred at 11:34 p.m. on August 10, 2017. A vehicle hit the right side of tunnel portal, and the accident resulted in 36 deaths and 13 injuries, causing wide publicity. In this communication, the causes of the accident were preliminarily studied and the hidden dangers of the accident in technology were discussed. Although the road design conforms to China's design standards, there is still room for improvement. To prevent the occurrence of such accidents and reduce the losses as much as possible when the accident occurred, the better design standards should be set. Further, the construction and operation departments should strengthen coordination to make sure traffic safety could be considered fully.

Key words: Xi'an-Hanzhong Expressway; tunnel traffic accident; technical deficiencies; traffic safety; reflection

高原驾驶员换道眼动特征

柯辉，王丽丽
（长安大学）

摘 要：究驾驶员在高原环境下换道过程的眼动特征，在 109 国道上纳赤台到昆仑山段进行实车试验，利用 SMI 眼动软件获得驾驶员的眼动数据，对不同高原驾驶经验驾驶员换道前跟驰阶段及换道意图阶段的眼动参数及注视特征进行对比研究，并根据马尔科夫理论计算高海拔下超车过程各阶段的注视平稳分布概率。通过对急进高原驾驶员以及常驻高原的驾驶员在高海拔的直线路段进行超车换道时的注视特征的对比分析，对初入高原的驾驶员的换道行为起到一定的指导约束作用。

关键词：高原环境；换道两阶段；眼动特征；注视平稳分布

Eye Movement Characteristics of Drivers in Plateau

Ke Hui, Wang Lili
(Chang'an University)

Abstract:

In order to obtain the eye movement characteristics of the driver overtaking in the plateau environment, the actual vehicle test was carried out on the 109 National Highway from Nachitai to Kunlun Mountain. The SMI was used to obtain the driver's eye movement data. The driver's eye movement parameters and gaze characteristics before the lane change and the intention of the lane change are compared. The Markov theory is used to calculate the gaze distribution probability at each stage of the overtaking process at high altitude. Through the comparative analysis of the gaze characteristics of the driver of the steep plateau and the driver of the permanent plateau in the high-altitude straight line segment, the driver's lane change behavior of the first-time plateau is played a certain guiding role.

keywords: Plateau environment; Two-lane; Eye movement characteristics; Fixation distribution characteristics

作者简介:柯辉，长安大学，18672292327@163.com。

考虑换道异质性与碰撞因素中观交通流仿真

孙智诚，史雪莹，朱彤
（长安大学）

摘 要：为研究中观交通流仿真中换道异质性对交通流特征的影响，完善交通流仿真中因碰撞导致拥堵产生与消散在建模中的特征。本仿真基于Netlogo平台中Traffic 2 Lanes model模型，重构了基于多智能体系统的三车道路段中观交通流，对交通流仿真方法进行改进，使其可以更加真实的表现出现实环境中拥堵产生和消散。通过标定数据，部署换道异质性行为与碰撞因素模型，并通过Netlogo仿真得到所需数据。利用仿真数据，研究换道异质性驾驶人群体的换道特征、车辆速度特征和时空分布。仿真结果分析表明：在不发生事故的前提下，积极的换道特性最多可以提高路段 7%的平均车速；当交通流达到临界密度后，考虑换道异质性和碰撞因素的模型表现出通行能力恶化程度更为严重，平均车速仅有不考虑上述因素模型的 70%；碰撞这一因素的加入可以更加真实的仿真交通流特征。以上研究，有助于更好地建立中观交通流仿真，为更好的理解拥堵的产生和消散的自发性提供参考。

关键词：交通工程；换道异质性；碰撞；多智能体系统；中观交通流仿真

Considering Lane Change Heterogeneity and Collision on the Mesoscopic Traffic Flow Simulation

Sun Zhicheng, Shi Xueying, Zhu Tong
(Chang'an University)

Abstract:

In order to study the influence of lane change heterogeneity on traffic flow characteristics in mesoscopic traffic flow simulation, and improve the characteristics of congestion generation and dissipation caused by the collision in traffic flow simulation. Based on the Traffic 2 Lanes model in the NetLogo, this simulation reconstructs the traffic flow of the three-vehicle road segment based on the multi-agent system and improves the traffic flow simulation method so that it can more realistically display the congestion in the real environment. Through the calibration data, a series of mesoscopic traffic flow simulation data is obtained with the lane change heterogeneity behavior and collision factor model are deployed in traffic simulation. Using the simulation data, the lane changing characteristics, vehicle speed characteristics and space-time distribution of the lane change heterogeneous driver group are studied. The simulation results show that the positive lane changing characteristics can increase the average speed of 7% of the road section without accidents. When the traffic flow reaches the critical density, the model considering the heterogeneity of lane change and collision factors shows that the deterioration of traffic capacity is more serious, and the average speed is only 70% of the model without considering the above factors; the addition of the collision factor could simulate the traffic flow characteristics more realistically. The above research will help to better establish the mesoscopic traffic flow simulation and provide a reference for better understanding the spontaneous generation of congestion generation and dissipation.

keywords:traffic engineering; lane change heterogeneity; collision; multi-agent system;

mesoscopic traffic flow simulation

作者简介:孙智诚，长安大学，szc_chd@163.com。

草原道路环境下驾驶员动态视觉特性研究

吉柯，王海晓，戚春华
（长安大学；内蒙古农业大学；内蒙古农业大学）

摘 要：城市道路的驾驶员动态视觉研究较为成熟，为了研究草原道路驾驶员的动态视觉特性，以城市道路作为对照组，分别在草原和城市道路开展实车试验。利用 K-means 聚类分析法划分驾驶员的注视区域特性；统计驾驶员注视时间的分布特性并进行拟合优度检验；运用马尔科夫理论求解驾驶员视觉转移概率矩阵及平稳分布，得出草原道路高频注视区域和视觉转移模式。结果表明相对于城市道路：草原道路环境下驾驶员的注视区域划分相对更少；驾驶员注视时间普遍偏长，近似服从于对数正态分布；驾驶员视线停留在当前注视区域的概率普遍较大；驾驶员更关注道路远端的注视区域。

关键词：草原道路；眼动行为；聚类分析；视觉特效；交通安全

Research on Dynamic Visual Characteristics of Drivers in Prairie Road Environment

Ji Ke, Wang Haixiao, Qi Chunhua
(Chang'an University; 内蒙古农业大学内蒙古农业大学)

Abstract:

The research on driver's dynamic visual of urban roads is relatively mature. In order to study the visual characteristics of prairie road drivers, urban roads were used as control group, and vehicle tests were carried out on prairie and urban roads respectively. K-means cluster analysis method is used to divide the fixation area characteristics of drivers. The distribution characteristics of drivers' fixation time were calculated and the goodness of fit test was carried out. Markov theory is used to solve the probability matrix and stationary distribution of driver visual transition, and the high frequency fixation area and visual transfer mode of prairie road were obtained. The results show that, compared with urban roads, the number of fixation areas of prairie road drivers is relatively less. The fixation time of prairie road drivers is generally long, which approximately subject to lognormal distribution. The probability of the driver to stay in the current fixation area is generally higher. Compared with the urban road, the driver pays more attention to the remote fixation area of the road.

keywords:prairie road; eye movement behavior; cluster analysis; visual characteristics; traffic safety

作者简介：吉柯，长安大学，2017221212@chd. edu. cn。

驾驶员对市区道路横向干扰危险感知特性研究

熊豪，刘茹月
（长安大学公路学院）

摘 要：本文根据城市道路环境的交通特征以及城市道路多发事故形态，设置了 6 处不同类型的横向干扰危险场景。分析驾驶员在各个场景的眼动数据，探索研究了驾驶人在各个危险场景下的感知时间，视线分布，水平视角分布等感知特性。研究结果表明：感知时间的长短与危险场景的设置参数有一定关联；不同场景驾驶人注视视线主要分布在右下区域；女性驾驶人的感知时间比男性驾驶人感知时间长；女性驾驶人的视线分布范围比男性驾驶人视线分布范围窄。

关键词：横向干扰；危险感知；感知特性

Research on Drivers' Perception Characteristics of Urban Road Horizontal Interference Hazard

Xiong Hao, Liu Ruyue
(Chang'an University)

Abstract:

According to the traffic characteristics of urban road environment and the multiple accidents of urban roads, six different types of horizontal interference hazard scenarios are set. The eye movement data of the driver in each scene is analyzed, and the perception characteristics such as the perception time, line of sight distribution and horizontal angle distribution of the driver in various dangerous scenes are explored. The results show that the length of the perception time is related to the setting parameters of the dangerous scene; the driver's eyes are mainly distributed in the lower right area; the female driver's perception time is longer than that of the male driver; the female driver's sight The distribution range is narrower than that of male drivers.

keywords: Lateral interference; hazard perception; perceptual characteristics

作者简介：熊豪，长安大学公路学院，2992261335@qq.com。

中国驾驶员换道行为分析

刘茹月，熊豪
（长安大学公路学院）

摘 要：分析换道的行成条件，对换道行为进行简单的分类，并将换道分为换道意图与决策阶段和换着执行阶段两个阶段。通过城市道路条件下进行实车试验，获取到了中国驾驶员的换道数据，进行数据的统计分析。从换道持续时间、方向盘最大转角、侧向加速度，TTC 等方面切入，分析中国不同驾驶员群体的换道行为特性。

关键词：车道变换；驾驶员；行为特性；TTC

Analysis of Chinese Driver's Lane Change Behavior

Liu Ruyue, Xiong Hao
(Chang'an University)

Abstract:

This paper analyzes the conditions of lane change, classifies the lane change behavior simply, and divides the lane change into two stages: the lane change intention and the decision phase and the exchange execution phase. Through the real vehicle test under urban road conditions, the Chinese driver's lane change data was obtained, and statistical analysis of the data was performed. From the change of lane change duration, steering wheel maximum angle, lateral acceleration, TTC, etc., the characteristics of lane change behavior of different driver groups in China are analyzed.

keywords:lane change; driver; behavior science; TTC

作者简介:刘茹月，长安大学公路学院，2322563774@qq.com。

不同曲率及转向的城市水下隧道驾驶人扫视特征研究

焦方通,杜志刚,蒋锦港,倪玉丹
（武汉理工大学交通学院）

摘 要：为研究驾驶人在城市水下隧道中不同曲率及转向条件下的扫视特性，利用同一隧道中 400m、680m、1000m 半径的弯道段以及直线路段开展实车试验。对驾驶人扫视角度的分布范围、平均值和中位值等基本指标做描述性统计分析，并将左右转弯的扫视角度数在[0,45]区间内等分为 9 个区段做细致研究。引入变异系数分析扫视角的离散性，并结合不同曲率弯道中的通视距离探求驾驶人的扫视特性。研究结果表明，在城市水下隧道各线形及转向中，驾驶人的扫视角都以小角度扫视为主，随着线形曲率的减小，扫视角的离散性更强。在相同曲率的弯道中行驶时，驾驶人右转比左转的行车状况更为稳健，但随着曲率的减小，左右转弯的扫视特征差异变小。

关键词：城市水下隧道；弯道路段；不同转向；视觉特性；扫视角

Research on Drivers' Saccade Characteristics of Urban Underwater Tunnel with Different Curvatures and Turnings

Jiao Fangtong, Du Zhigang, Jiang Jingang, Ni Yudan
(Wuhan University of Technology)

Abstract:

In order to research the drivers' saccade characteristics of urban underwater tunnel with different curvatures and turnings, a real vehicle experiment was carried out on curved and straight sections with radius of 400 m, 680 m and 1000 m in the same tunnel. Descriptive statistical analysis was carried out on the basic indicators such as the distribution range, average and median of driver's saccade angles, and the saccade angles of left-turn and right-turn were equally divided into 9 sections in [0,45] interval for detailed study. The coefficient of variation was introduced to analyze the discreteness of saccade angles, and the saccade characteristics of drivers were explored by combining the visual distance in different curvature curves. The results show that the main saccade angle of drivers is small angle in different alignments and turnings of the urban underwater tunnel. With the decrease of curvature, the discreteness of saccade angle is stronger. When driving in a curve with the same curvature, the driver's right-turn is more steady than the left-turn. But with the decrease of curvature, the difference of saccade characteristics between left-turn and right-turn becomes smaller.

keywords:urban underwater tunnel; curved road; different turnings; visual characteristic; saccade angle

作者简介:焦方通，武汉理工大学交通学院，jiaofangtong@126.com。

Placement Distance of Exit Advance Guide Sign on an Eight-Lane Expressway Considering Lane Changing Behavior

Liang Guohua (China)
长安大学公路学院
lgh@chd.edu.cn

Ma Yanfeng (China)
长安大学
2017121141@chd.edu.cn

Li Rui (China)
长安大学公路学院
2017021076@chd.edu.cn

Shi Borui (China)
东北林业大学交通学院
shiborui@nefu.edu.cn

Sun Xujiao (China)
长安大学公路学院
2018321046@chd.edu.cn

Abstract: The reasonable location of the advance guide sign (AGS) plays an important role in improving driving efficiency and safety to exit the expressway. Particularly, some of two-way four-lane expressways, built in the early stage in China, will be extended to be two-way eight lanes in conformity with economy and traffic development, which will increase the lane change difficulties for drivers travelling from the innermost lane. By analysing the two-way eight-lane changing process to the upcoming exit, we modified the lane change distance formula of the traditional AGS model. To this end, a field experiment was designed to explore the lane change transverse time at the 1st Level of Service (LOS). Considering limitations of the experiment equipment, a discussion to lane change distance at worse levels of service was made by VISSIM simulation, where vehicle composition, speed limits of each lane and the exit rate of the innermost lane are considered. The results show that the eight-lane changing distance based on modified theoretical calculations, at a design speed of 120km/h, is 579m, and placement distance of the final AGS is 749m. Lane change distance discussed by VISSIM simulation, revealed to be 590m at the 1st LOS with minor difference to 579m which proved the validity of theoretical calculations. Further, placement distance of the worse levels of service are discussed and recommended to be 3 km, 2 km, 1.2 km and 0.8km, considering the driver's short-term memory calculation formula. Determining the two-way eight-lane AGS placement distance from the perspective of LOS can provide a basis for the supplement of the existing standards and reference for the AGS placement distance after lane extension of expressway in China.

Key words: advance guide sign; lane change distance; field experiment; levels of service; traffic simulation

Research on the Classification for Road Traffic Visibility Based on the Characteristics of Driving Behaviour-A Driving Simulator Experiment

Wang Kun，Zhang Weihua，Feng Zhongxiang，Yuan Quan，Wang Cheng
Hefei University of Technology；Hefei University of Technology

Abstract： The purpose of this study was to perform fine classification of road traffic visibility based on the characteristics of driving behavior under different visibility conditions. A driving simulator experiment was conducted to collect data of speed and lane position. ANOVA was used to explore the difference of driving behavior under different visibility conditions. The results show that only average speed is significantly different under different visibility conditions. With the visibility reducing, the average vehicle speed decreased. The road visibility conditions in the straight segment can be divided into five levels: less than 20 m, 20-30 m, 35-60 m, 60-140 m and more than 140 m. The road visibility conditions in curve segment can be also divided into four levels: less than 20 m, 20-30 m, 35-60 m and more than 60 m. These conclusions help to establish more accurate control measures to ensure road traffic safety under low visibility conditions.

Key words： traffic safety; driving simulator experiment; speed; lane position; low visibility

作者简介：王锟，合肥工业大学，wkun@mail.hfut.edu.cn。

基于 Kaplan-Merir 法的等红灯期间驾驶员玩手机行为研究

李帅，肖新梁，朱成明
（河南理工大学）

摘 要：等待红灯期间驾驶员玩手机行为会影响交叉口车辆的通行效率，带来一定的交通安全隐患。为研究驾驶员在红灯期间的玩手机行为及其重要影响因素，本文采用生存分析法中的 Kaplan-Merir 法建立基于心理等待忍耐时间的生存函数模型。结果表明:等待时间越长，玩手机率越高；有交警执法驾驶员等待忍耐时间比无交警执法更长；相同的等待时间下，男性驾驶员玩手机率比女性驾驶员高。通过 VISSIM 仿真评价表明，当驾驶员等红灯期间玩手机时，交叉口 10min 将通行能力约减少 33.4%。

关键词：玩手机；影响因素； Kaplan-Merir 法；等红灯忍耐时间

A Study on Driver's Behavior of Playing Mobile Phone While Waiting for Red Light Based on Kaplan-Merir Method

Li Shuai, Xiao Xinliang, Zhu Chengming
(河南理工大学)

Abstract:

The driver's behavior of playing mobile phone during red light will affect the traffic efficiency of vehicles at the intersection and bring some traffic safety risks. In order to research this behavior and its important factors, the Kaplan-Merir method in the survival analysis was used to establish the survival function model based on the psychological waiting time. The results showed that the longer the waiting time, the higher the rate of playing mobile phones. Drivers are likely to wait longer with the traffic police than those without; For the same waiting time, male drivers play more than female drivers. The VISSIM simulation results show that when drivers play with mobile phones during red lights, the traffic capacity of intersections will be reduced by 33.4% in 10 minutes.

keywords: Playing mobile phone; Influencing factors; Kaplan - Merir method; Waiting patience time

作者简介:李帅，河南理工大学，1527137853@qq.com。

基于驾驶负荷的高速公路事故多发段鉴别方法

周颖，吕能超，谢练，吴超仲
（中交第二公路勘察设计院研究有限公司；武汉理工大学智能交通系统研究中心；武汉理工大学；武汉理工大学）

摘 要：高速公路交通事故发生与驾驶员驾驶负荷高低存在密切关系，从驾驶负荷角度进行交通安全量化备受关注；借助汽车模拟驾驶器与生理测量仪等设备开展了驾驶实验，选取心率变异率作为驾驶负荷量化指标，探究了道路平纵线形指标、标志牌信息量、道路服务水平对驾驶负荷的影响；在道路交通环境单因素驾驶负荷评价模型基础上，结合离差标准化法和专家权重法，建立了综合驾驶负荷评价方法；通过统计路段单元驾驶负荷值与事故率值，发现当综合驾驶负荷超过 0.41 时路段事故率显著上升，可确定为驾驶负荷安全阈值；实例应用证明，基于驾驶负荷的事故多发段鉴别模型具有可行性，且鉴别的结果与常用累计频率曲线法相比较，识别事故多发段具有路段短、精度高的特点。

关键词：交通安全；事故多发路段；综合评价；高速公路；驾驶负荷

Freeway Accident-Prone Section Identification Approach Based on Driving Workload

Zhou Ying, Lv Nengchao, Xie Lian, Wu Chaozhong
(中交第二公路勘察设计院研究有限公司; Intelligent transportation system research center, Wuhan University of Technology; Wuhan University of Technology; Wuhan University of Technology)

Abstract:

Freeway traffic accident is highly correlated with driving workload level. In order to measure and evaluate the impact of road alignment, traffic sign, traffic flow on drivers' mental workload, the driving experiment based on driving simulation system and physiological data acquisition system were designed and carried out. Physiological data were collected and data analysis confirmed that the heart rate variability can be used as a sensitive index of driving mental workload. The comprehensive evaluation method of driving workload was proposed based on index normalization method and expert scoring method which determines the weight of each index. The driving workload safety threshold was obtained by statistical results of driving workload data and accident data. Data analysis indicated that the accident rate increased significantly when the comprehensive driving workload value exceeded 0.41. The safety threshold of workload can be set according to the conclusion. The illustration on real freeway showed that the accuracy of accident-prone section identification based on driving workload approach was higher compared with cumulative frequency curve method's, which indicated that accident-prone section identification approach based on driving workload is feasible.

keywords: Traffic safety; Accident-prone section; Comprehensive evaluation; Freeway; Driving workload

作者简介:周颖，中交第二公路勘察设计院研究有限公司，363126932@qq.com。

低等级公路光学长隧道驾驶员视觉负荷研究

王首硕,杜志刚,刘海阁,陈云
（武汉理工大学交通学院；武汉理工大学交通学院；中交瑞通路桥养护科技有限公司；武汉理工大学交通学院）

摘 要：为了进一步分析低等级公路光学长隧道内不同车型、不同区域驾驶员的视觉负荷负荷特性，选取 22 名驾驶员进行实车实验，利用眼动仪采集驾驶员瞳孔面积的变化数据，并对实验数据进行分析。结果表明：（1）隧道入口、出口段之间（P=3.465E-10），以及小车驾驶员与货车驾驶员之间（P=0.034）的瞳孔面积变化速率均值存在显著性差异，车型与隧道区域两个因素之间对瞳孔面积变化速率无交互影响（P=0.890）。（2）货车驾驶员在进出隧道视觉负荷更严重，货车驾驶员（1.5 mm2•s-1）在隧道内的瞳孔面积增大变化率峰值大于小车驾驶员（1.2 mm2•s-1），货车驾驶员（-1.69 mm2•s-1）减小变化率峰值大于小车驾驶员（-1.1 mm2•s-1）；（3）货车车型、出口区域对驾驶员在公路隧道对视觉环境更为敏感，不同车型（P=0.0487）、不同隧道区域（P=0）的驾驶员的瞳孔面积变化速率变异系数有显著差异。

关键词：交通安全；低等级公路；光学长隧道；瞳孔面积；视觉负荷

Research on Driver's Visual Load of Low-Grade Highway Optical Long Tunnel

Wang Shoushuo, Du Zhigang, Liu Haige, Chen Yun
(Wuhan University of Technology; Wuhan University of Technology; 中交瑞通路桥养护科技有限公司; Wuhan University of Technology)

Abstract:

In order to analyze the visual load characteristics of different models and regions in low-grade highway optical long tunnels, 22 drivers were selected for real vehicle experiments, and the change data of the pupil area of the driver was collected by eye tracker, and the experimental data was analyzed. The results show that: (1) there is a significant difference in the average rate of change in pupil area between the entrance and exit sections of the tunnel (P=3.465E-10) and the driver of the Car and the truck (P=0.034). There was no interaction between the two factors in the tunnel area on the rate of change in pupil area (P=0.890). (2) The visual load of the truck driver in the tunnel is more serious. The peak rate of the pupil area increase in the tunnel (1.5 mm2•s-1) is greater than that of the car driver (1.2 mm2•s-1). The truck driver's (-1.69 mm2•s-1) peak value of the change rate is greater than that of the driver of the car (-1.1 mm2•s-1); (3) the truck model and the exit area are more sensitive to the visual environment for the driver in the road tunnel. Drivers of different vehicle types (P=0.0487) and different tunnel areas (P=0) have significant differences in the coefficient of variation of the pupil area change rate.

keywords: Traffic safety; low-grade highway; optical long tunnel; pupil area; visual load

作者简介:王首硕，武汉理工大学交通学院，254923434@qq.com。

Experience Teaches: Examining Difference Between External and Internal Distractions in Car Following Among Inactive and Active Drivers

Dong Hongming, Tian Junfang
Tianjin University

Abstract: Driving is a complex task that not only require handling skills but also the ability to process a lot of information under temporal constraints. However, there are various sources of distraction in the driving environment. Drivers contend with both external and internal distractions while driving. Compared to the extensive efforts in recent years to understand the mechanisms of external distraction (i.e. interaction with passengers, cell phone use), relatively little is known about internal distraction such as mind wandering. Equally worrying is that there are growing number of inactive drivers who got driving license very early, but didn't drive afterwards. Whether different distractions have different have different effects on drivers? Considering the faster we drive, the greater the rate of information flow we have to process, will inactive drivers more affected by the increasing of speed for their limited driving skills? In order to explore these questions, the current study investigated the effect of both external and internal distractions exerts on driving performance in six speed levels. Twelve inactive drivers and twelve active drivers participated in this driving simulator experiment. The analysis revealed that both drivers perceive greater cognitive workload when they are distracted especially in internal distraction. This was also reflected in the physiological parameters. Distractions impaired active drivers' driving performances in more cases compare to inactive drivers. And in the vast majority of cases, with or without distractions, active drivers outperformed inactive drivers in driving performance. On this basis, the implications of these findings are discussed.

Key words: driver distraction; internal distraction; driving performance; driving simulator

作者简介：董宏铭，天津大学，806711798@qq.com。

基于 CART 决策树研究出租车驾驶员驾驶行为对事故的影响

张福明,牛凯,李贵阳
（长安大学）

摘 要：在出租车事故中，人的因素是主要影响因素，驾驶员的驾驶行为与事故严重程度息息相关。基于 CART 决策树算法，对 2014~2015 年西安、西宁、长春及汕头的出租车驾驶员及事故数据进行挖掘分析，探究驾驶员驾驶行为对事故严重程度的影响。结果表明，驾驶员单手操作，禁区停车，开车聊天，随意闯红灯，疲劳驾驶等因素对事故严重度的影响较大。这些不良驾驶行为会增加事故的严重程度，并且驾驶员不良驾驶行为越多，发生严重交通事故的机率越大。此外，本研究说明了 CART 决策树在出租车事故严重程度分析中具有可行性与有效性。

关键词：出租车事故；驾驶行为；CART；分类；决策树

Analysis of the Impact of Taxi Driver Driving Behavior on Accidents Based on CART Decision Tree

Zhang Fuming, Niu Kai, Li Guiyang
(Chang'an University)

Abstract:
In taxi accidents, the human factor is the main influencing factor, and the driver's driving behavior is closely related to the severity of the accident. Based on the CART decision tree, the taxi drivers and accident data of Xi'an, Xining, Changchun and Shantou from 2014 to 2015 were mined and analyzed to explore the impact of driver's driving behavior on the severity of the accident. The results show that the driver's one-hand operation, parking in the restricted area, running red light, fatigue driving and other factors have a greater impact on the severity of the accident, these poor driving behaviors will increase the severity of the accident. And the more drivers drive bad driving, the greater the chance of serious traffic accidents. This study illustrates the feasibility and effectiveness of CART decision trees for the analysis of accident severity.
keywords:taxi accident; driving behavior; CART; classification; decision tree

作者简介:张福明，长安大学，1092134319@qq.com。

Exploring Factors Influencing Risky Cycling Behaviors of Young Cyclists: A Questionnaire-Based Investigation in China

Wang Cheng, Zhang Weihua, Feng Zhongxiang, Wang Kun
Hefei University of Technology; Hefei University of Technology

Abstract: Road traffic crashes are the leading cause of death for young people, among whom cyclists account for a higher percentage of risk of injury or death than any other road users. The purpose of this study was to develop and test a questionnaire comprising the young cyclist behavior questionnaire (YCBQ), risk perception (RP) scale and cycling skill inventory (CSI), then to explore the relationship among gender, risk perception, cycling skills, and risky cycling behaviors of young people. The data were collected from 448 young Chinese cyclists. First, exploratory factor analysis and confirmatory factor analysis were conducted to determine the dimensions of the questionnaires. According to the results, good reliability and validity were presented by all the analysis groups, including the 5-dimensional YCBQ, which consisted of traffic violations, impulsive behaviors, ordinary violations, distractions, and personal control errors; the one-dimensional RP scale concerning risk perception; and the 3-dimensional CSI, which measured perceptual skills, safety motives, and operational skills. Furthermore, a structural equation model that considered gender, risk perception, cycling skill, and risky cycling behaviors was constructed to explore the potential relationships among the variables. The results showed that gender, risk perception, and cycling skills all have negative significant influences on risky cycling behavior. This study was conducted to help policy makers and traffic managers develop effective educational plans and intervention measures and ultimately to improve the safety of young cyclists.

Key words: Young cyclists; Risky cycling behaviors; Risk perception; Cycling skill inventory

作者简介：汪程，合肥工业大学，hfwang19@mail.hfut.edu.cn。

Research on Lane-Changing Duration and Trajectory with Consideration of Vehicle Lateral Stability

Liu Yuwen, Hong Chen, Sun Xiaoke
Chang'an University

Abstract: When vehicles are driving on the expressway section, due to the factors such as fast speed, changeful road alignment and complex environment, the possibility of vehicles lateral instability caused by collision or improper timing of lane change will be greatly increased. So in this paper, by analyzing the influencing factors of lane-changing duration, the ultra high curve section and double lane changing test were used respectively as the road model and driver operation model. With lateral acceleration, lateral force coefficient and lateral-load transfer ratio as the evaluation indexes, at 80 km/h, 100 km/h and 120 km/h speed, lane-changing longitudinal displacement critical value of 50 m, 70 m and 85 m respectively could guarantee the lateral stability of vehicle. And the lane-changing longitudinal displacement was positively correlated with the lane-changing speed by transverse comparison. At last, the lane-changing duration data obtained from the simulation test was extracted, and it was obtained that the lane-changing duration concentrated in the range of 1.8~12.2s under different vehicle speeds. The rationality and accuracy of the simulation results were verified by comparing the results of existing literature. The lane-changing lateral moving-trajectory curve was drawn to provide support for future research on lane-changing trajectory fitting and prediction.

Key words: traffic engineering; lane-changing trajectory; lateral stability; lane-changing duration; CarSim

作者简介：刘玉雯，长安大学，453133501@qq.com。

中国路怒现状调查分析与对策

李凡, 陈尧, 方琪璐, 朱文清, 王卫杰
（南京工业大学）

摘 要：近年来，路怒事件的发生率及其导致的交通事故起数呈现逐年上升趋势，由路怒引起的事故、纠纷频频见诸报端，“路怒症”已经严重威胁人们的出行安全。因此，本文基于179起真实路怒事件，分析了中国路怒事件的特征及演变模式，并进一步从立法、驾驶培训两个角度提出了路怒的干预方法。

关键词：路怒症；致因分析；干预对策

Investigation and Analysis Intervention of Road Rage in China

Li Fan, Chen Yao, Fang Qilu, Zhu Wenqing, Wang Weijie
(NanJing Tech University)

Abstract:

In recent years, the incidence of road anger incidents and the number of traffic accidents caused by them have been increasing year by year. Accidents and disputes caused by road anger have frequently appeared in newspapers. Road anger has seriously threatened people's safe travel. Therefore, based on 179 real road anger incidents, this paper analyzes the characteristics and evolution patterns of road anger in china . Finally, this paper proposes the intervention method of road rage from the two perspectives of legislation, driving training.

keywords:road rage; cause analysis; intervention strategy

作者简介:李凡，南京工业大学，lifan2013@qq.com。

Cognitive Bias Analysis of Observation Ability of Novice Drivers Based on Questionnaire Data

Wang Xiang (China)
长沙理工大学
158995646@qq.com

Liu Xuemei (China)
长沙理工大学
1203376089@qq.com

Hao Wei (China)
长沙理工大学
haowei@csust.edu.cn

Abstract: The research on driving ability of novice drivers is an important direction in the field of driving safety. The self-cognition and objective assessment of driving ability of novice drivers are usually different. This paper aims at analyzing novice drivers' observation ability with driving based on questionnaire survey data. The comparison analysis of self-assessment and mutual-assessment of novice drivers' ability were used to explore the cognitive bias which maybe caused safety hazard. In addition, this paper also analyzed the driving ability influence of demographics factors and driving experience factors, consists of sex, education, major, driving year, driving frequency and driving time. The results are useful for driving policy and technical assistance for novice drivers to keep driving safety.

Key words: novice driver; driving ability; observation ability; driving safety

Effects of Connected Vehicles of Fog Warning System on Driver Performance Based on Driving Simulator

Chen Yufei, Zhao Xiaohua, Xu Wenxiang
Beijing University of Technology

Abstract: Foggy day has low visibility, which has the great impact on driving behaviors, thus, it easily causes serious traffic crashes. Fog warning systems can convey warning messages to drivers, therefore, it is conducive to reduce crashes. This research aims at exploring the effects of fog warning systems on driver performance by analyzing drivers' behaviors to Dynamic Message Sign (DMS) and Human Machine Interface (HMI). In order to achieve this aim, an effective Connected Vehicles (CV) testing platform is established based on driving simulator and driver performance data under DMS and HMI were collected. The experiment route was divided into three different zones (i.e., warning zone, transition zone, and heavy fog zone), and mean speed, mean acceleration were selected. The Results indicate that fog warning system is beneficial to reduce speed before drivers enter the fog zone. The CV testing platform based on driver simulator developed in this paper provides a new method for evaluating the effectiveness of CV warning system in adverse conditions.

Key words: Fog warning system; Dynamic message sign; Human Machine Interface; Driver performance; Connected Vehicles; Driving simulator

作者简介：陈雨菲，北京工业大学，chenyufei@emails.bjut.edu.cn。

The Impacts of Dialing Cell Phone on Driving Behavior

Zhao Weihua (China)
西安航空学院
16277317@qq.com

Wu Chuna (China)
交通运输部公路科学研究院
234926920@qq.com

Xia Hongwen (China)
交通运输部公路科学研究院
171646012@qq.com

Li Yuhan (China)
西安航空学院
499316460@qq.com

Abstract: Cell phone use while driving is a pretty common phenomenon, but its danger is not recognized adequately, let alone attracts wide intention. In order to assess the effects of dialing cell phone on road safety in driving condition, a real car test was conducted. 60 participants were recruited and divided into three groups according to driving skill, and each participant was required to complete dialing cell phone task separately in stationary condition and driving condition. In the stationary condition, we measured the time each participant took to complete the dialing task (static task completion time), and in the driving condition the following 4 parameters were measured: driving task completion time, driving distance, speed decreases and the number of lane departure. Then, the change rule of each parameter was analyzed for each group with the method of statistical analysis. The statistics indicated that during the dialing task in the driving condition, drivers spent more than 60 percent of the time in dialing instead of detecting road information and this proportion for skilled drivers is even higher. At the same time, the dialing task would also result in the phenomenon of vehicle traveling track deviation and speed decrease. The study showed that dialing the cell phones had negative impact on driving. It caused drivers distracted, influenced driving stability and made drivers unable to deal with emergencies.

Key words: dialing cell phone; task completion time; driving distance; speed decreases; lane departure

基于功率谱的跟驰行为速度差分析

张敏, 齐龙, 温常磊, 张香, 马小龙
（长安大学；长安大学；长安大学；长安大学；中交第一公路勘察设计研究院有限公司 交通安全应急保障技术交通运输行业研发中心）

摘 要：为了研究车辆不同跟驰类型(小型车-小型车、小型车-大型车、大型车-大型车、大型车-小型车)在高速公路出口上速度差的内在规律，利用无人机航拍，实现了在真实道路交通环境下对驾驶人跟驰行为特性的数据采集，并以实测数据为基础，利用 tracker 提取出车辆的速度，计算出跟驰车辆间的速度差，进而得出四种跟驰类型的时域谱图和功率谱图，结果表明速度差值由小到大为：大型车-小型车、小型车-小型车、大型车-大型车、小型车-大型车；按照不同跟驰类型的功率谱图，小型车-小型车的速度差周期性强，大型车-大型车速度差呈现周期性，但是规律性弱于小型车-小型车，小型车-大型车和大型车-小型车的速度差混乱，无明显规律性。研究结果对于公路车辆分型、分道行驶以及高速路出口跟驰行为模型的建立具有一定的理论意义。

关键词：功率谱

Analysis of Car-Following Types Based on Power Spectrum

Zhang Min, Qi Long, Wen Changlei, Zhang Xiang, Ma Xiaolong
(Chang'an University; Chang'an University; Chang'an University; Chang'an University; 中交第一公路勘察设计研究院有限公司交通安全应急保障技术交通运输行业研发中心)

Abstract:

In order to study the inherent law of speed different in the following different types (car following car, car following truck , truck following car, truck following truck) on the freeway exit, we use aerial drones to get date that is characteristic of driving people following behavior in the real road traffic environment .we use tracker to extract the vehicle speed and to calculate the following difference between the vehicle speed on the basis of the measured data ,then we can get four types of time-domain spectrum and power spectrum in different car –following types .The results show that the speed difference is from small to large: car following truck, car following car, truck following truck, truck following car .According to the power spectrum of different types of following the car following car speed difference is cyclical, truck following truck speed difference is cyclical, but the regularity is weak than car following car, truck following car and car following truck speed difference is chaotic and do not have obvious regularity .The research results have certain theoretical significance for the classification of highway vehicles, lane separation and the establishment of highway exit following behavior model.

keywords: Power spectrum

作者简介:张敏，长安大学，zhangmin3709@163.com。

Game Analysis of Pedestrian-Vehicle Interactive State on Efficiency at Signalized Intersection

Zhang Na, Li Yu
Chang'an University

Abstract: Pedestrian-vehicle interactive operation exists at urban signalized intersection widely. To improve the efficiency and safety of signalized intersections in urban, it is necessary to study the behavior of pedestrians and vehicles in interactive state. This paper analyzed operational efficiency based on game analysis under pedestrian-vehicle interactive operating state at urban signalized intersection. According to the decision-making behavior of both sides, we established a non-cooperative game model, a cooperative game model and a threat game model to identify the benefit situation of pedestrians and vehicles. The result shows that cooperative game can improve the traffic efficiency of pedestrian-vehicle interactive operation state, and it should be used as a common criteria for both in the interactive operation. Further this research demonstrates that it is reasonable to study the effect of each decision combination on the efficiency of pedestrian-vehicle interaction based on the analysis of pedestrian decision.

Key words: traffic engineering; signalized intersection; double matrix model;pedestrian-vehicle interaction;game analysis

作者简介：张娜，长安大学，2774890542@qq.com。

基于 NS 模型的疲劳驾驶行为分析

李荀，卢欢欢
（长安大学）

摘 要：研究表明，疲劳驾驶是导致交通事故的主要原因之一，且由其引发的道路交通事故导致了严重的人身伤亡和财产损失。本文对累计驾驶时间和驾驶员反应时间进行相关性检验，确认疲劳驾驶和反应时间有显著的正相关关系；通过对 NaSch 模型进行改进，选择合适的参数，进行单车道交通流的模拟实验，记录模拟数据，得出不同反应时间和事故的概率的相关系数及显著性水平，进而得到疲劳驾驶对交通安全的影响，并从降低驾驶员不良行为的角度提出有效降低交通事故率的切实可行的对策和建议。

关键词：疲劳驾驶；反应时间；NaSch 模型；交通安全；相关性分析

Analysis of Fatigue Driving Behavior Based on NS Model

Li Xun, Lu Huanhuan
(Chang'an University)

Abstract:

Research shows that fatigue driving is one of the main causes of traffic accidents, and the road traffic accident caused by it caused serious personal injury and property damage. Correlation test between driving time and driver’s response time was made, and confirmed that there is a positive correlation between fatigue driving and reaction time. By improving the NaSch model and selecting the appropriate parameters, simulation experiment of single lane traffic flow was conducted, the correlation coefficient and the significance level of the different reaction time and probability of the accident are obtained, and then the impact of fatigue driving on traffic safety is obtained. From the perspective of reducing the driver's bad behavior, put forward practical countermeasures and suggestions to effectively reduce the traffic accident.

keywords: Fatigue driving; Reaction time; NaSch model; Traffic safety; Correlation analysis

作者简介:李荀，长安大学，809449230@qq. com。

驾驶员疲劳行为研究综述

王畅
（重庆交通大学）

摘　要：机动车保有量的逐年增长，道路交通事故发生率也相应攀升，而出行需求的扩大也伴随着人们出行安全意识的加强。疲劳驾驶是驾驶过程中的常见现象，也威胁着人们的出行安全，本文从生理学、生理学及人机工程学的角度出发，研究疲劳产生特征及影响因素，为更好地防治与消除驾驶员疲劳，科学的研发疲劳检测及预警系统提供研究依据，也为相关法律法规的制定提供理论支撑。

关键词：疲劳驾驶

A Review of Driver Fatigue Behavior

Wang Chang
（Chongqing Jiaotong University）

Abstract:

The annual increase in the number of motor vehicles and the corresponding increase in the number of road accidents have also led to an increase in people's travel safety awareness. Fatigue driving is a common phenomenon in the driving process, but also threaten people's travel safety. In this paper, from the point of view of physiology, physiology and ergonomics, the characteristics and influencing factors of fatigue are researched to provide the research basis for better prevention and control of driver fatigue, scientific research and development of fatigue detection and early warning system, and also for the relevant laws and regulations Provide theoretical support for the formulation.

keywords: fatigue driving

作者简介：王畅，重庆交通大学，1356151260@qq.com。

An Application and Extension of the Theory of Planned Behavior to Analyze Takeaway Deliverers' Red-Light Running Behavior in China

Zhang Fan
Chang'an University
1435551970@qq.com

Lv Huitao
Chang'an University

Shen Xiaoyan
Chang'an University

Abstract: The red-light running (RLR) rate of takeaway deliverers riding electric bikes (e-bikes) in China is very high, resulting in a considerable number of traffic accidents. This paper aims to utilize the theory of planned behavior (TPB) to investigates the psychological characteristics of takeaway deliverers' RLR intentions. A survey questionnaire was designed to collect data, including extended variables (i.e., descriptive norms, conformity tendency, and traffic environment) and demographic information combined with the three basic components of TPB. The survey was conducted in Xi'an, and 228 completed questionnaires were collected. The reliability and validity of the data were tested for each item. Structural equation model (SEM) was used to examine the data, and then multiple group analysis on demographic variables was conducted. The results showed that the modified TPB model had better model fit comparing with the hypothesis and original TPB models. As for the extended constructs, conformity tendency and traffic environment were significant predictors, however, attitude was the strongest predictors of all variables examined for RLR intentions. In addition, the path parameters of the modified TPB model were basically adapted to different demographic groups. These results could provide a basis for the delivery platform and traffic management department to design intervention measures and safety education schemes to reduce RLR behaviors among takeaway deliverers.

Key words: the theory of planned behavior; structural equation model; red-light running; multiple group analysis; takeaway deliverer

基于异质性驾驶行为与碰撞的中观交通流仿真

史雪莹，孙智诚，朱彤

（长安大学）

摘　要：为研究现实中驾驶行为异质性及其对交通流特性的影响，采用问卷的方法调查了驾驶人受周围车辆车速、交通流密度、碰撞事故等因素的影响所表现出的异质性驾驶行为。问卷结果表明驾驶人受周围车辆速度影响会不同程度地调整自身车速；交通流密度及可接受的排队停车次数决定驾驶人的换道行为；碰撞事故的发生会降低驾驶人车速同时改变驾驶风格。接着结合调查的数据参数，利用 NetLogo 软件建立了基于多智能体系统的无出入口路段中观交通流模型，将异质性驾驶行为及碰撞因素部署到模型中仿真交通流的演化过程，弥补了以往中观交通流模型的缺陷。仿真结果表明驾驶人的平均车速与驾驶人特性有关；换道行为异质性使各车道车辆分布呈潮汐式变化，影响交通流的稳定性；事故碰撞导致的交通瓶颈，使交通流运行效率下降。以上研究更为真实地反映了交通流状态，为更好地理解与模拟中观交通流变化提供了新的依据。

关键词：异质性驾驶行为；中观交通流仿真；交通工程；多智能体系统

Mesoscopic Traffic Flow Simulation Based on Driving Behavior Heterogeneity and Collision

Shi Xueying , Sun Zhicheng , Zhu Tong

（Chang'an University）

Abstract:

To study the heterogeneity of driving behaviors in reality and its influence on traffic flow characteristics, a questionnaire survey was conducted to investigate the heterogeneity of driving behaviors under the influence of surrounding vehicle speed, traffic flow density, collision accidents and other factors. The results of the questionnaire showed that drivers adjusted their own speed to different degrees under the influence of surrounding vehicles' speed. Drivers' lane changing behavior was determined by the traffic flow density and the acceptable number of stops; Collision accidents reduced the driving speed and change the driving style. Combined with the data parameters of the heterogeneity investigation of driving behavior, NetLogo was then used to establish the meso-traffic flow model which contains a road section without entrance and exit based on the multi-agent system. Heterogeneous driving behavior and collision factors were deployed into the model to simulate the evolution process of the traffic flow, which compensated the defects of the previous meso-traffic flow model. The simulation results show that the average driving speed is related to the characteristics of the driver. The heterogeneity of lane-changing behavior makes the distribution of vehicles in each lane change in a tidal manner and affects the stability of traffic flow. The traffic bottleneck caused by collision makes the efficiency of traffic flow decrease. The above

research truly reflects the traffic flow statues and provides a new basis for better understanding and simulating traffic flow changes.

keywords: heterogeneous driving behavior; mesoscopic traffic flow simulation; traffic engineering; multi-agent system

作者简介：史雪莹，长安大学，1343156359@qq.com。

The Motorcycle Child Helmet Initiative Project (MCHI) Protocol of SAFEKIDS Malaysia Universiti Putra Malaysia

Kulanthayan KC Mani (Malaysia)
Safe Kids Malaysia Universiti Putra Malaysia
kulan@upm.edu.my

Vaidehi Ulaganathan (Malaysia)
Management and Science University Malaysia
vaidehi_ulaganathan@msu.edu.my

Kaviyarasu Yellappan (Malaysia)
Safe Kids Malaysia Universiti Putra Malaysia
safekidsmalaysia@upm.edu.my

Tamil Selvi Arumugam (Malaysia)
Safe Kids Malaysia Universiti Putra Malaysia
selvi_2601@yahoo.com

Nor Afiah Mohd Zulkefli (Malaysia)
Department of Community Health, Universiti Putra Malaysia
norafiah@upm.edu.my

Abstract: Appropriate motorcycle helmet usage protects child riders from serious injuries and road crash death. A head injury is the main cause of motorcycle crash fatalities for both adult and child riders. The implementation of the Motorcycle Safety Helmet Law in Malaysia in 1973 helped improve the prevalence of standard helmet usage among adult riders; however, the prevalence of standard motorcycle child helmet usage among child pillion riders continues to have worrying levels. Early advocating for child motorcycle helmets is important as the prevalence of motorcycle crash fatalities persists over time. MCHI is a school-based program promoting standard child motorcycle helmet usage among primary school children. The program, to date, is implemented in 22 primary schools in the state of Selangor. The efficacy of this intervention may maximise the usage of standard child motorcycle helmet.

Key words: Randomised controlled trial; standard motorcycle child helmet; primary school; Malaysia

Desired Safety Margin Model-Based Exploration of Driver Style Effect on Heterogeneous Traffic Flow

Zhang Junjie , Yu Haiyang , Ren Yilong , Lu Guangquan , Yang Can , Liu Miaomiao
Beihang University Beihang University Beihang University Beihang University 北京航空航天大学合肥创新研究院 Beihang University

Abstract: Driver style plays a key role in influencing stability in heterogeneous traffic flow. This study aims to explore the impact of different driver styles on heterogeneous traffic flow stability on the basis of a microscopic car-following model, namely, desired safety margin (DSM) model. The DSM model is used to portray the psychological behavior, operation behavior, and performance of the driver in terms of response time by using five driving behavior parameters, namely, the upper and lower limits of the DSM, sensitivity coefficient of acceleration and deceleration, and response time. Driving behavior characteristics would cause a dynamic phase transition for single-lane traffic flow. Five driving behavior characteristics constitute driver style in this paper. Analytical results indicate that driver styles and their proportions play a key role on the stability of heterogeneous traffic flow. We found that a driver who is responsive, sensitive, and risk-averse is stable, and a driver who is unresponsive, insensitive, and risk-prone is unstable based on the results of numerical simulation experiments. Therefore, increasing the proportions of responsive, sensitive, and risk-averse driver styles and decreasing the proportions of unresponsive, insensitive, and risk-prone driver styles can help improve heterogeneous traffic flow stability. Moreover, the traffic flow is always stable regardless of the proportions of the driver styles when all the drivers are stable. However, if a platoon has stable and unstable drivers, then the proportion of drivers with different driver styles plays a key role in traffic flow stability. These results are useful in developing a traffic control strategy to stabilize traffic flow by adjusting driver styles and their proportions.

Key words: Desired safety margin; Driver style; Heterogeneous traffic flow; Stability; Driving behavior parameter

Conflict Analysis of Non-Motorized Vehicles on Isolated Bicycle Lane

Wang Lin , Wei Zhonghua , Qiu Shi , Wang Shaofan
Shandong Transportation Institute Beijing University of Technology Beijing University of Technology Beijing University of Technology

Abstract: The accident risk on bicycle lane has been increasing with the number of non-motorized vehicles (NMV) roaring in China recent years. In real-world traffic environment, three types of NMV, namely bicycles (B), electric bicycles (EB), and electric tricycles (ET) share the limited right-of-way of the bicycle lane, which complicates the traffic conflict. This paper analyzes NMV conflicts on bicycle lane using statistical analysis and regression analysis. The video logs are collected from three selected isolated bicycle lanes in Beijing. Two-dimensional trajectory tracking method is applied to characterize the NMV flow. The relationship between various traffic conflicts and traffic density as well as reverse riding ratio is examined, respectively. Results indicate two remarkable findings: 1) densities of B, EB, and ET, which are mostly influenced by speed, are correlated with different types of conflicts; 2) the EB conflict shows a strong linear correlation with EB density. Based on the above analysis, the linear prediction model of opposing conflict is established using reverse riding ratios of B, EB, and ET. This research recommends that reverse riding of NMV should be eliminated to reduce the bicycle lane conflict. Moreover, the travel speed of NMV on bicycle lane should be further regulated to provide safe and friendly riding environment for riders.

Key words: Conflict; Non-motorized vehicle; Bicycle lane; Traffic density; Reverse riding ratio

高速公路隧道洞口接近段视区优化研究

蒋锦港，杜志刚，徐弯弯，杨理波
（武汉理工大学）

摘　要：由于高速公路隧道的特殊构造和洞口接近段视区的不合理，车辆撞击隧道洞口事件高居不下。为了改善高速公路隧道洞口接近段的视区，提升隧道交通安全。首先对隧道洞门立面标记和线形诱导标进行组合设计出不同方案；然后采用 3ds Max 软件构建高速公路隧道仿真模型进行试验；采用 D-Lab 数据分析软件对视区进行兴趣区域划分，通过采集被试者的平均注视时间和兴趣区域浏览率作为试验指标；最后采用 SSPS 数据分析软件统计分析试验数据。试验结果表明：隧道洞门环形块立面标记+40m 间距线形诱导标方案的夜间和白天平均注视时间最小，分别为 18.002ms 和 16.051ms，夜间和白天前方区兴趣浏览率最大，分别为 47.8%和 60.6%，对高速公路隧道洞口接近段视区的改善效果最好。

关键词：隧道安全；立面标记；线形诱导标；平均注视时间；兴趣区域

Research on Optimization of Viewport of Approaching Section of Highway Tunnel Entrance

Jiang Jingang , Du Zhigang , Xu Wanwan , Yang Libo
（Wuhan University of Technology）

Abstract:

Due to the special structure of expressway tunnel and unreasonable proximity of viewport of the approaching section of highway tunnel entrance, incidents of vehicles' hitting the tunnel entrance is high. In order to improve the viewport of approaching section of highway tunnel entrance and to improve the traffic safety of tunnels. First, different schemes are proposed for the combined design of the tunnel portal elevation mark and the linear guidance mark. Then 3ds Max software is used to build a highway tunnel simulation model for testing. D-Lab data analysis software is used to divide the region of interest into the viewport. The average gaze time of the subjects and the interest area browsing rate are collected as test indicators. Finally, SSPS software is used to analyze test data. The experimental results show that the ring block elevation marking of tunnel portal + the linear guidance marking scheme set at 40m spacing has the shortest nighttime and daytime gaze time, which are 18.002ms and 16.051ms respectively. And its night and daytime front area has the highest interest rate, 47.8% and 60.6% respectively. It has the best effect on improving the tunnel entrance near the section of highway tunnels. It has the best effect on improving the tunnel entrance of the highway tunnel.

keywords: tunnel safety; facade marking; linear induction; average gaze time; saccade angle area of interest

作者简介：蒋锦港，武汉理工大学，1425304663@qq.com。

基于刑事判决文书数据挖掘的醉酒驾驶行为特征分析

杨洁，范洁
（东南大学）

摘　要：论文依托 2013 年至 2016 年期间江苏省全省各基层人民法院审结的近 2 万份醉酒型危险驾驶罪判决书，进行醉酒驾驶行为的信息提取与特征分析，挖掘醉酒驾驶行为涉及的人、车、路、环境特征之间的关联特性，为我国醉酒驾驶安全风险防控提供完善建议。

关键词：醉酒驾驶；司法裁判文书；数据挖掘；特征分析

Analyzing Characteristics of Drunk Driving Behaviors Based on Data Mining of Criminal Judicial Documents

Yang Jie , Fan Jie
（Southeast university）

Abstract:

This paper analyzes characteristics of drunk driving behaviors by extracting basic information from nearly 20,000 judicial documents of drunken driving crime handed down by the local people's courts of Jiangsu, China from 2013 to 2016. The correlative characteristics among human, vehicle, road and environmental characteristics involved in drunk driving behaviors are excavated, followed by risk prevention measures for Chinese road traffic safety concerning drunk driving.

keywords: drunk driving; criminal judicial document; data mining; characteristic analysis

作者简介：杨洁，东南大学，jieyang@seu.edu.cn。

螺旋立交匝道汽车横向运行特性研究

刘俊，徐进
（重庆交通大学）

摘　要：本文通过自然驾驶实验研究横向加速度特性， 24 位不同职业的驾驶员采用自然驾驶的方式驾驶汽车通过实验立交匝道，以此获得了大量的实验数据。基于自然驾驶试验数据，对速度、横向加速度等运行参数分析了螺旋匝道路段车辆运行特性、横向加速度变化趋势以及横向舒适性。主要研究发现为：（1）由于苏家坝立交匝道路段的单向陡坡特性导致螺旋匝道路段车辆速度波动幅值较大。（2）螺旋匝道路段女性驾驶员对车辆速度控制较男性驾驶员差。（3）横向加速度在螺旋匝道路段变化趋势有明显的阶段性特征，下行匝道呈稳定上升和线形下降两阶段变化；上行匝道呈前期线性增加、中期稳定波动、后期线性下降三阶段变化。（4）行驶过程中的慢行车辆阻滞、超车、紧急避让等行为会显著降低横向加速度的幅值，甚至使其方向改变。(5)横向加速度累计频率图分析发现横向加速度二次突变位置不是普遍认同的 85th 百分位而是在 90th-95th 百分位。（6）下行行车舒适性较上行稍好，就上行行车舒适性而言上行阶段 I 的舒适性比轨迹半径更小的阶段 II 差。

关键词：自然驾驶；螺旋匝道；横向加速度；速度；行车舒适性

Study on Transverse Operation Characteristics of Automobile on Ramp of Spiral Interchange

Liu Jun , Xu Jin
（Chongqing Jiaotong University）

Abstract:

In this paper, the transverse acceleration characteristics are studied by natural driving experiment. twenty-four drivers of different occupations use natural driving to drive the car through the experimental interchange ramp, so as to obtain a large number of experimental data. Based on the natural driving test data, the vehicle operation characteristics, transverse acceleration change trend and transverse comfort of spiral ramp section are analyzed for the operating parameters such as speed, transverse acceleration and so on. The main findings are as follows: (1) due to the one-way steep slope characteristics of Sujiaba interchange ramp section, the amplitude of vehicle speed fluctuation in spiral ramp section is large. (2) The speed control of female drivers is worse than that of male drivers in spiral ramp section. (3) The change trend of transverse acceleration in spiral ramp section has obvious stage characteristics, and the downlink ramp changes in two stages: stable rise and linear decrease; The uplink ramp changes in three stages: the linear increase in the early stage, the stable fluctuation in the middle stage and the linear decrease in the later stage. (4) The slow-moving vehicle block, overtaking, emergency avoidance and other behaviors in the process of driving will significantly reduce the amplitude of transverse acceleration, or even change its direction. (5) The analysis of the cumulative frequency diagram of transverse acceleration shows that the secondary mutation position of transverse acceleration is not the generally accepted 85th

percentile but in the 90th-95th percentile. (6) The comfort of the downlink is slightly better than that of the uplink, and the comfort of the uplink stage Ⅰ is worse than that of the stage Ⅱ with a smaller trajectory radius.

keywords: natural driving; spiral ramp; transverse acceleration; driving comfort

作者简介：刘俊，重庆交通大学，564066429@qq.com。

基于自然驾驶数据的螺旋立交匝道路段汽车行驶轨迹研究

潘存书

（重庆交通大学）

摘　要：为掌握汽车在螺旋立交匝道上的行驶轨迹特性，开展了螺旋立交匝道自然驾驶试验，获得了多条不同特征驾驶人的行车轨迹。通过分析，得到如下结论：1）在自然行驶状况下，驾驶人在匝道上习惯于选择内侧车道行驶；2）驾驶人整体上有靠近匝道中心线行驶的倾向，即行驶区域在左、右车道中心线之间且车身一般不越过匝道中心线；3）汽车在螺旋曲线匝道上的轨迹偏移量存在不同程度的波动，在 600m 左右的螺旋曲线内，轨迹曲线的波峰个数在 1~4 个之间，对应的 85 分位平均横移速率为 0.13m/s；4）相较于大转角的螺旋曲线，在转角较小的匝道区域，汽车轨迹形态具有明显的差异，主要有正常、校正型以及切弯型等几种轨迹类型；5）不同性别和驾驶经验的驾驶人的轨迹偏移量在匝道各横断面上没有显著差别；6）在不同车道上，女性驾驶人的行驶区域比男性驾驶人要稍微向车道弯侧平移；7）有经验驾驶人的行驶区域更靠近车道中心线，相比之下，无经验驾驶人的行驶区域则稍向匝道中心线靠拢。

关键词：行驶轨迹

Research on Vehicle Trajectory of Spiral Interchange Ramp Based on Natural Driving

Pan Cunshu

（Chongqing Jiaotong University）

Abstract:

In order to grasp the characteristics of the trajectory of the vehicle on the spiral interchange, the natural driving test of the spiral interchange was carried out, and the driving trajectory of the driver with different characteristics was obtained. Through analysis, the following conclusions are obtained: 1) Under natural driving conditions, the driver is accustomed to selecting the inner lane ;2) the driver has a tendency to travel near the center line of the ramp, in other words, the driving area is between the center line of left and right lane but the body generally does not cross the centerline of the ramp; 3) The trajectory offset of the car on the spiral curve ramp has different degrees of fluctuation.,and in the spiral curve of about 600m, the number of peaks of the trajectory curve is 1 to 4, and the corresponding 85-bit average traverse rate is 0.13 m/s;4) Compared with the spiral curve, the trajectory of the car is obviously different in the curve with smaller rotation angle, mainly including several types of trajectories such as normal, correction and bending; 5) The trajectory offset of drivers with different genders and driving experience is not significantly different in each section of the ramp; 6) In different lanes, the driving range of the female driver is slightly shifted to the curved side of the lane than the male driver; 7) The driving area of the experienced driver is

closer to the lane center line, and in contrast, the driving area of no experience driver is slightly closer to the center line of the ramp.

keywords: vehicle trajectory

作者简介：潘存书，重庆交通大学，1574227154@qq.com。

基于 k-means 和遗传算法的定制公交线路优化

王超
（兰州交通大学）

摘　要：为了合理地制定定制公交线路方案以提高定制公交的运行效率，针对目前定制公交线路优化方法欠缺的问题，以及基于遗传算法求解的在进行定制公交线路优化建模时忽略上车区域到下车区域的那段距离，或者将其设定为定值的问题，提出一种基于 K-means 和遗传算法的混合优化算法。首先采用改进的 K-means 聚类算法对实际路网中存在的定制公交乘客上车站点进行聚类分析，考虑上车站点之间的距离及各上车站点的乘客需求数量等因素，获得有明确划分的不同簇的路网图。其次以路网中多辆定制公交车总运营里程最小为优化目标，考虑车辆的容量约束、线路上座率等约束，构建了满足多个停车场多辆定制公交车的线路优化模型，模型中的目标函数分为四个部分，完整的体现了定制公交车在路网中的运行过程。在此基础上，采用遗传算法，运用自然数编码机制，将每个站点作为基因位，采用上车站点和下车站点分开编码的方式，依据车辆容量约束采用贪心策略进行解码，进而得到不同车辆的站点访问顺序，经过遗传算子操作最终得到问题的满意解。最后用 c++编程，借助 VC++6.0 平台求解以兰州市城关区为背景的实际算例，求解时间为 30.5s，得到的优化线路上座率高达 91.875%，为验证此求解结果的正确性，采用手动求解所有的 50 条染色体，求解结果与计算机求解结果一致，说明算法与模型的正确性。算例结果表明：此求解结果既满足实时性要求，又能充分利用定制公交资源；基于 K-means 和遗传算法的混合优化算法对于求解多个定制公交停车场多个上下车站点多辆车的线路优化问题具有很强的可行性和有效性。研究结果对于探索定制公交线路优化方法，提高定制公交的运行效率具有重要价值。

关键词：交通规划；定制公交；线路优化；k-means 算法；遗传算法；贪心策略

Optimization of Customized Bus Routes Based on K-Means and Genetic Algorithm

Wang Chao
（Lanzhou Jiaotong University）

Abstract:

In order to reasonably formulate the scheme of customized bus routes to improve the operation efficiency of customized bus routes, aiming at the shortcomings of current optimization methods for customized bus routes, and the problem of ignoring the distance between boarding area and alighting area or setting it as a fixed value in the process of customized bus routes optimization modeling based on Genetic algorithm, a new method based on K-means and genetic algorithm is proposed. Hybrid optimization algorithm. Firstly, the improved K-means clustering algorithm is used to cluster the customized bus passengers'boarding points in the actual road network. Considering the distance between the boarding stations and the number of passengers' demands at the boarding stations, the different cluster road maps with clear division are obtained. Secondly, taking the minimum total operating mileage of multi-customized buses in the road network as the optimization objective,

considering the constraints of vehicle capacity and line occupancy, a route optimization model for multi-parking and multi-customized buses is constructed. The objective function of the model is divided into four parts, which fully reflects the operation process of customized buses in the road network. On this basis, using genetic algorithm and natural number coding mechanism, each station is regarded as a gene locus, and decoding is carried out by greedy strategy according to vehicle capacity constraints. The satisfactory solution of the problem is finally obtained by genetic operator operation. Finally, a practical example with the background of Chengguan District in Lanzhou City is solved by using C++ programming and VC++ 6.0 platform. The solution time is 30.5 seconds, and the optimum route occupancy rate reaches 91.875%. To verify the correctness of the solution results, all 50 chromosomes are solved manually, and the results are consistent with those obtained by computer, which shows the correctness of the algorithm and the model. The results show that the solution not only meets the real-time requirement, but also makes full use of customized bus resources. The hybrid optimization algorithm based on K-means and genetic algorithm is feasible and effective for solving the route optimization problem of multiple customized bus parks, multiple stations and multiple vehicles. The research results have important value for exploring the optimization methods of customized bus routes and improving the operation efficiency of customized bus..

keywords: transportation planning; customized bus; route optimization; k-means algorithm; genetic algorithm; greedy strategy

作者简介：王超，兰州交通大学，chaochaowang199518@163.com。

Safety Analysis and Structure Optimization of Corrugated Guardrail of Expressway

Du Xuejing
Northeast Forestry University
duxuejing99@163.com

Abstract: In order to study the crashworthiness of the corrugated beam guardrail of the expressway, the finite element model of the standard 94 version wave beam guardrail, small passenger cars, medium passenger cars, medium trucks and large trucks were established to analyze the crashworthiness, guiding performance, and occupant safety of the corrugated beam guardrail. According to the 《Safety Performance Evaluation Standard for Highway Guardrails》 (JTG B05-01-2013), the collision simulation tests were carried out under different speed conditions with different car. Based on the simulation test results, the existing 94 version standard guardrail can no longer meet the requirements the guardrail safety. Then, the original structure of 94 version standard guardrail was improved by two schemes. The conclusions can be obtained through simulation collision test that the lateral dynamic deformation of the improved scheme 1 is 535.05mm, 945.15mm and 968.22mm, which meet the deformation requirements of the guardrail. However, the lateral dynamic deformation of the improved scheme 2 is 1354.3mm, 1250.5mm and 703.28mm, which do not meet the deformation requirements of guardrail, which is prone to problems such as excessive deformation of the guardrail and straddle accidents, but the guidance and occupant safety are better. In order to address the problems mentioned above, the structure optimization is carried out further more. The lateral dynamic deformation of the structure optimization scheme 1 guardrail was reduced to 327.3mm, 715.73mm and 935.13mm, the lateral dynamic deformation of the structural optimization scheme 2 was reduced to 857.99mm, 925.29mm and 764.13mm, both meet the requirements of the deformation of the guardrail and have good crashworthiness. The orientation and occupant safety are good and meet the design requirements.

keywords: wave beam guardrail; double-wave plate guardrail; crashworthiness; structure optimization

Estimating Speed of Dynamic Traffic Shockwaves for Bottleneck Detection in a Connected Vehicle Environment

Jiang chenli , Tony Qiu
Department of Civil and Environmental Engineering University of Alberta

Abstract: Traffic state estimation is important for active traffic planning, management, and control. By utilizing the traffic status over time and space, the shockwave theory-based tool can be efficient to solve bottleneck detection problems. This paper proposes a method for dynamic traffic shockwave estimation, with both high temporal resolution and high spatial resolution. The method is based on integrating vehicle detection system data from fixed loop detectors and trajectory data from probe vehicles in a connected vehicle environment. In detail, a modified compressed sensing framework is proposed for shockwave speed estimation, in order to reveal the characteristics of traffic flow. The proposed method is validated using the prevailing next-generation simulation (NGSIM) dataset. The results show that the proposed method combines the advantages of mobile and fixed data. In conclusion, the proposed method is effective in improving the spatial and temporal resolution of shockwave estimation in the considered general scenario, where bottlenecks are successfully detected.

Key words: Dynamic Shockwave Estimation; Bottleneck Detections; Connected Vehicles; Compressed Sensing; Dynamic Shockwave Estimation; Bottleneck Detection; Connected Vehicles; Compressed Sensing

路段行人优先与传统行人过街延误分析

张勇，王永岗，林永
（长安大学）

摘　要：当下，行人过街的行人优先形式和传统过街形式的各自利弊，使得如何处理过街行人与机动车冲突成为广为关注的问题之一。本文针对行人过街的传统形式和行人优先形式下行人和机动车运行特性，利用 VISSIM 仿真软件对两种形式过街进行交通仿真并输出过街行人延误和机动车延误等参数，进而分析两种行人过街形式下的优缺点，最后对处理过街行人与机动车冲突提出建议。

关键词：行人优先；传统过街；交通仿真；延误

Delay Analysis on Road Section Under the Pedestrian Crossing Priority and Traditional Pedestrian Crossing

Zhang Yong , Wang Yonggang , Lin Yong
（Chang'an University）

Abstract:

At present, both pedestrian crossing priority and traditional pedestrian crossing had their own advantages and disadvantages, which had become one of the most concerned issues. In this paper, for the characteristics of pedestrian crossing and traffic flow under pedestrian crossing priority and traditional pedestrian crossing, simulation software VISSIM was used to simulate the two forms of pedestrian crossing. Though simulation, parameters including average pedestrian crossing delay and average vehicle delay were produced. According to the results, the advantages and disadvantages of two pedestrian crossing were analyzed. Finally, suggestions to deal with the conflicts between pedestrians and vehicles were handled.

keywords: pedestrian crossing priority; traditional pedestrian crossing; traffic simulation; delay

作者简介：张勇，长安大学，13279376385@163.com。

多车场 CARP 问题的改进遗传算法求解

龚金俦，马昌喜
（兰州交通大学）

摘　要：带有容量限制的弧路径问题（CARP）针对的是对路径进行服务的应用。本文针对多车场带有容量限制的弧路径优化问题借助启发式算法遗传算法与 dijkstra 算法混合优化算法进行优化。首先，通过改进 dijkstra 算法得到最短弧距离矩阵及前驱路径，将得到的数据使用最短距离法进行系统聚类分析，对实际路网图进行科学的聚类划分得到具体的服务弧划分区域。因区域划分产生的边界弧通过改进的 dijkstra 算法以及阈值进行调整。在得到完整聚类信息的基础上使用改进的遗传算法，采用实数编码方式将每条路径当作基因位，使用片段式交叉算子和基因对换变异算子，以车辆承载能力作为约束通过染色体基因优先策略进行解码，进而得到具体的解码路径（以节点表示）。最后以兰州市某区路网数据作为实验数据，使用 Matlab 语言实现算法在洒水车应用方面的实用性，借此保证了算法的正确性和可行性。

关键词：遗传算法；带有容量限制的弧路径问题；系统聚类分析

Improved Genetic Algorithm for Multi-Vehicle CARP Problem

Gong Jinchou , Ma Changxi
（Lanzhou Jiaotong University）

Abstract:

The Capacitated Arc Routing Problem (CARP) is for the application of the path service.In this paper, the arc path optimization problem with multi-vehicle field with capacity limitation is optimized by heuristic algorithm genetic and dijkstra hybrid optimization algorithm. Firstly, the shortest arc distance matrix and the precursor path are obtained by the improved dijkstra algorithm. The obtained data is clustered by the shortest distance method, and the actual road network diagram is divided by the scientific clustering to obtain the specific service arc division area. The boundary arc resulting from the region division is adjusted by the improved dijkstra algorithm and the threshold. Based on the complete clustering information, an improved genetic algorithm is used, and each path is treated as a gene position by real number coding, and a segmentation crossover operator and a gene swapping mutation operator are used. The chromosomal gene prioritization strategy is used to decode the vehicle carrying capacity as a constraint, and a specific decoding path (represented by a node) is obtained.Finally, using the road network data of a certain district in Lanzhou as experimental data, Matlab language is used to realize the practicality of the algorithm in the application of sprinkler and ensure the correctness and feasibility of the algorithm.

keywords: Genetic algorithm; Capacitated Arc Routing Problem; Systematic cluster analysis

作者简介：龚金俦，兰州交通大学，1023909650@qq.com。

高速铁路路堑——高架桥过渡段气动效应风洞试验研究

张景钰，张明金，李永乐，郭俊杰
（西南交通大学）

摘　要：我国地形地貌复杂多变，线路交替必不可少，为了探究高速铁路路堑-高架桥过渡区域的列车气动效应和复杂风场，本文建立了大比例试验模型，采用风洞试验的方法对线路上方不同位置处的风速剖面和线路不同位置处的车辆气动力进行了测试。试验结果表明：高架桥-路堑过渡段对气流的影响范围在轨道上方 200mm（对应实际工程中的 4m）以内；线路交界处上方的风剖面受路堑和高架桥两种线路形式的影响；当风速变化时，列车沿线移动的气动力会出现浮动，但对变化趋势的影响有限；在过渡区域，线路交界处附近对行车安全最不利，且路堑侧更为不利；受雷诺数效应的影响，气动力系数整体上随风速的增大而减小。

关键词：高速铁路；路堑-高架桥过渡段；风洞试验；列车气动特性；风剖面

Study on Aerodynamic Effects of Cutting-Viaduct Connection Area in High-Speed Railway Using Wind Tunnel Tests

Zhang Jingyu , Zhang Mingjin , Li Yongle , Guo Junjie
（Southwest Jiaotong University）

Abstract:

The topography and geomorphology are complex and changeable in China, and the railway transition zones are indispensable, in order to investigate the vehicle aerodynamic effects and complex wind field in embankment-cutting transition zone, a large-scale model was established to measure the wind velocity profiles above the track and the train aerodynamic forces at different locations along the track by using wind tunnel test method. The test results show: The influence height of cutting-viaduct transition zone on air flow is less than 200mm (corresponding to 4m in full scale) above the track. The wind velocity profile at the railway junction is affected by cutting and viaduct jointly. Also, when the wind speed changes, the aerodynamic coefficients of the vehicle along the track fluctuates, but its influence on the changing trend is limited. In the transition zone, it is the most unfavorable for traffic safety near the junction of the railway, especially at the side of cutting. The aerodynamic coefficients decrease while the wind speed increases due to the Reynolds number effect.

keywords: high-speed railway; cutting-viaduct connection area; wind tunnel test; vehicle aerodynamic characteristics; wind velocity profile

作者简介：张景钰，西南交通大学，729305307@qq.com。

考虑动物穿行的高海拔地区生态交通运营保障措施研究

韩万里，赵建有，郭万江，赵阳
（长安大学）

摘　要：为了降低高海拔地区交通运营对动物穿行的影响，提出考虑动物穿行的高海拔地区生态交通运营保障措施。从高海拔地区特殊的地理人文条件入手，采用行车样线法，在青海省共玉高速公路展开实地调查。首先，以咨询专家、走访当地民众、交通管理部门协助的方式对共玉高速公路沿线牧区和自然保护区与动物穿行相关的情况进行调查、分析取证；然后，从车辆与动物碰撞事故、公路交通对环境影响及生境阻隔及破碎化方面对公路交通对其沿线动物及环境影响进行分析。调查分析结果表明：在共玉高速公路沿线时有车辆与动物碰撞事故，放牧通道利用率不高，且没有设置动物穿行警告标志；造成车辆与动物碰撞事故发生频率及动物死亡率高，对其沿线环境、生态、生境阻隔及破碎化的影响较大。最后对设计高海拔地区动物穿行警示标志，并提出设置建议；根据国标 JTJ074-94 对公路沿线牧区护栏网优化设置；提出对野生动物保护区动物通道环境营造优化措施，可为工程技术人员具体设计工作提供依据，也可为国家标准的修订与进一步完善提供理论依据。

关键词：高海拔地区；交通运营；动物穿行；生态交通；安全保障措施

Study on Eco-Transportation Operation Guarantee Measures in High Altitude Area Considering Animal Traveling

Han Wanli , Zhao Jianyou , Guo Wanjiang , Zhao Yang
（Chang'an University）

Abstract:

In order to reduce the impact of traffic operation on animal travel in high altitude areas, we propose to consider the ecological traffic operation safeguard measures in high altitude areas. Starting from the special geographical and human conditions in high altitude areas, we conducted a field survey on Gongyu Expressway in Qinghai Province by using the driving sample line method. Firstly, we investigate, analyze and collect evidence about animal travel in pastoral areas and nature reserves along Gongyu Expressway by consulting experts, visiting local people and assisting traffic management departments. Then, we analyze the impact of road traffic on animals and environment along the road from the aspects of vehicle-animal collision accident, road traffic impact on environment, habitat barrier and fragmentation. Investigation and analysis results show that there are collision accidents between vehicles and animals along Gongyu Expressway, the utilization rate of grazing passage is not high, and there is no warning sign of animal crossing. They result in high frequency of vehicle-animal collision accidents and high mortality rate of animals, which have a great impact on the environment, ecology, habitat barrier and fragmentation along the route. Finally, we designed the warning signs for animals traveling in high altitude areas and put forward suggestions for setting them. According to the national standard JTJ074-94, we optimize the setting of pastoral fence network along the highway.The measures for optimizing the environment of animal

passage in wildlife reserve were put forward. They can provide a basis for the specific design work of engineers and technicians, and also provide a theoretical basis for the revision and further improvement of national standards.

keywords: High Altitude Area; Traffic Operation; Animal Travel; Ecological Transportation; Safety Guarantee Measures

作者简介：韩万里，长安大学，593596511@qq.com。

Enhancing Real-Time Crash Risk Prediction Performance Considering Spatial and Temporal Correlations in Machine Learning Models

Liu Tong
Southeast university
liut@seu.edu.cn

Li Zhibin
Southeast university

Abstract: Unobserved heterogeneity in crash data could affect the predicting accuracy of crash risks. Such effects can be considered within the spatial and temporal correlation to improve the model prediction performance. This study aims at proposing two enhanced machine learning model, Support Vector Machine model (SVM) and Decision Tree model (DT), that involves the spatial and temporal weight features in the model structure to address the spatial and temporal proximity in the real-time crash risk predictions. A total of 254 crash data on the Interstate 80 were obtained. Traffic flow data 5 min before the occurrence of each crash were extracted to be the case database. Non-crash traffic flow data were randomly extracted from the collision free periods to be the control database. The Receiver Operating Characteristics (ROC) curves were drawn to evaluate and compare the prediction performance of different models. The results showed that by incorporating the spatial and temporal correlations in the SVM, the model fitness was improved: the predicting accuracy was increased from 0.79 to 0.92 as compared to the basic SVM model, and from 0.89 to 0.92 for DT model. Two weight matrixes of spatial and temporal correlation in the SVM were tested, and the models with crash-weighted centroid-distance spatial weight feature had the highest predicting accuracy and AUC value. Findings of this study suggest that the proposed SVM model with the spatial and temporal correlation can effectively improve the predicting accuracy of real-time crash risks based on the traffic variables from loop detector stations.

Key words: Real-time crash risk prediction; Machine learning; Spatial and temporal correlations; Traffic safety

Horizontal Alignment Security Design Theory of Superhighway

He Yongming
Northeast Forestry University
hymjob@163.com

Pei Yulong
Northeast Forestry University

Abstract: The road top design speed of 120 km/h in China, first appeared in Highway Engineering Technical Standard (Trial) in 1956, but vehicle performance, road design and construction technology have been greatly improved after more than 60 years, in order to adapt to the development demand of highway design speed above 120 km/h in the future, studied the superhighway alignment design theory. Firstly, described the definition of the superhighway, determined the classification, and introduced the adaptive roads and motor vehicles. Then, calculated the length limit of straight line according to driver characteristics, determined the minimum radius of circular curve on the basis of stress analysis when vehicle is running. Finally, calculated the minimum length of transition curve, according to the centrifugal acceleration of vehicle when it is running, the travel time and the passengers visual characteristics. The calculation and analysis results show that superhighway linear feature is in conformity with the vehicle running characteristic, and superhighway technically feasible.

Key words: Superhighway; Security Design; Horizontal alignment; Circular curve

基于遗传神经网络和指数平滑的交通流预测

谭丽敏，马昌喜
（兰州交通大学）

摘　要：为了有效提高路段短时交通流预测的精度，提出了由遗传神经网络和指数平滑构成的组合模型。利用遗传算法的全局搜索能力优化 BP 神经网络的连接权值和阈值，避免 BP 神经网络陷入局部最优，建立了遗传神经网络预测模型；再建立了一次指数平滑预测模型。为了结合两个模型的优点，将二者通过加权平均组成组合模型，组合模型的权重根据单一模型的预测均方误差确定。采用合肥市以 5min 为观测间隔的道路交通流数据进行实验验证，并把 BP 模型、遗传神经网络模型、指数平滑模型和组合模型进行对比分析。结果表明，优化后的 BP 神经网络预测精度比优化前提高了 16.9%；组合模型的预测精度比两个单一模型分别提高了 7.8%和 16.8%，验证了该组合模型的可行性和有效性。

关键词：短时交通流预测；遗传神经网络；指数平滑；组合模型

Traffic Flow Prediction Based on Genetic Neural Network and Exponential Smoothing

Tan Limin , Ma Changxi
（Lanzhou Jiaotong University）

Abstract:

In order to improve the accuracy of short-term traffic flow prediction, a combined model composed of genetic neural network and exponential smoothing is proposed. Using the global search ability of genetic algorithm, the connection weight and threshold of BP neural network are optimized to avoid BP neural network falling into local optimum. An exponential smoothing prediction model is established then. In order to combine the advantages of the two models, the combination model is composed by weighted average, and the weight of the combination model is determined according to the prediction mean square error of the single model. The road traffic flow data of Hefei city with an observation interval of 5min were used for experimental verification, and the BP model, genetic neural network, exponential smoothing model and combination model were compared and analyzed. The results show that the prediction accuracy of the optimized BP neural network is 16.9% higher than that before the optimization. The prediction accuracy of the combined model is 7.8% and 16.8% higher than that of the two single models, verifying the feasibility and effectiveness of the combination model.

keywords: short-term traffic flow prediction; genetic neural network; exponential smoothing; combination model

作者简介：谭丽敏，兰州交通大学，769833821@qq.com。

Analysis of Influence of Traffic Monitoring on Drivers' Psychology in the Phrase of Signal Conversion

Pan Fuquan , Zhang Lixia , Ma Changxi
Qingdao Technological University Qingdao Technological University Lanzhou Jiaotong University

Abstract: In order to study physical and psychological influence of camera enforcement on vehicle drivers in the phrase of signal conversion, namely during the end of the green light and the yellow light signal, a physiological data test system consisting of psychological behavior synchronization recording system, a heart rate variability analysis system and other experimental equipment was constructed, then five drivers' physiological data was collected individually at the stages of before passing through the intersection, passing through the intersection and after passing through the intersection. The data were analyzed and matched with the sample T test. And the heart rate variability analysis was performed on the physiological data of No driver.1. The results show that during the end of the green light and the yellow light signal, the influence of camera enforcement on the driver's physiology and psychology is more significant. In the intersection without camera enforcement, drivers are more nervous at the phrase of passing through the intersection. In the intersection with camera enforcement, drivers are more nervous before passing through the intersection.

Key words: phrase of signal conversion; traffic monitoring; driving psychology; HRV

基于公交 GPS 数据的宁波市常规公交运行特征分析

张世杰，周继彪，郝海明，杨仁法

（长安大学 宁波工程学院 宁波工程学院 宁波工程学院）

摘　要：优先发展公共交通是缓解城市交通拥堵和维持城市可持续发展的重要举措。常规公交作为一体化城市公共交通体系的重要一环，其运行特征是影响乘客出行方式选择以及公交服务质量的重要因素，研究公交运行特征对于进一步增强公共交通的吸引力，提升公共交通服务质量、缓解交通拥堵等方面具有着重要作用。因此，基于公交 GPS 数据，对宁波市常规公交运行特征进行了分析。结果表明：同线路内同期运行的常规公交和社会车辆的车速以及行程时间差异明显。空间特征方面，公交的行车正点率和行程时间与公交线路沿途道路交通状态和公交线路非直线系数成负相关关系；时间特征方面，全时段线路行车正点率稍有差异并不明显，早、晚高峰对线路行车正点率影响轻微。研究结果为提升宁波市常规公交运行效率提供了有益参考。

关键词：交通工程；公交运行特征；GPS 数据；运行速度；常规公交

Analysis of the Characteristics of Conventional Public Transportation Operation in Ningbo Based on Big Data

Zhang Shijie，Zhou Jibiao , Hao Haiming , Yang Renfa

（Chang'an University Ningbo University of Tchnology Ningbo University of Tchnology Ningbo University of Tchnology）

Abstract:

Prioritizing the development of public transport is an important measure to alleviate urban traffic congestion and maintain urban sustainable development. As an important part of the integrated urban public transport system, the operational characteristics of conventional public transport are important factors affecting passengers' choice of travel mode and the quality of public transport service. Studying the operational characteristics of public transport plays an important role in further enhancing the attractiveness of public transport, improving the quality of public transport service and alleviating traffic congestion. Therefore, based on the bus GPS data, the operation characteristics of the conventional bus in Ningbo are analyzed. The results show that the speed and travel time of conventional buses and social vehicles running at the same time in the same line are obviously different. In terms of spatial characteristics, the bus punctuality rate and travel time are negatively correlated with the road traffic status along the bus line and the non-linear coefficient of the bus line; in terms of time characteristics, there is no significant difference in the full-time bus punctuality rate, and the early and late rush hours have a slight impact on the bus punctuality rate. The research results provide a useful reference for improving the efficiency of routine bus operation

in Ningbo.

keywords: traffic engineering; bus operating characteristics; GPS data; operating speed; bus

作者简介：张世杰，长安大学，2674904626@qq. com。

城市干路交叉口悬臂式交通标志遮挡失效研究

裴玉龙，郭明鹏
（东北林业大学交通学院 东北林业大学）

摘　要：为了分析城市干路上大型车对悬臂式交通标志遮挡的影响。首先，根据驾驶人视认交通标志过程和分析精度的要求，确定仿真路段长度及仿真步长两个参数取值，通过实地调查获取交叉口交通信号、交通量、车辆速度及道路参数等数据。其次，基于遮挡判断的要求，确定仿真模拟需要输出仿真时间、车辆坐标等数据。再次，根据车辆与交通标志间的几何关系，研究了遮挡的开始计数、终止计数及遮挡判定条件。最后，根据 VISSIM 仿真实验获得数据，进行交通标志遮挡失效概率分析。研究结果表明，原始数据下交通标志遮挡失效概率为 0.2432。在交叉口车道中车辆运行速度、绿信比不变的条件下，增加车道中大型车的数量和交通量，都会导致交通标志失效概率增加，两个影响因素与交通标志失效概率间都呈正相关。

关键词：城市干路交叉口；悬臂式交通标志；VISSIM；遮挡失效

A Study of Occlusion Failure of Cantilever Traffic Sign at Intersections of Urban Arterial Roads

Pei Yulong , Guo Mingpeng
（Northeast Forestry University）

Abstract:

In order to analyze the influence of large vehicles on cantilever traffic sign occlusion of the urban arterial intersection. Firstly, according to the process of traffic sign recognition and the requirement of analysis accuracy, the parameters of simulation section length and simulation step length are determined, and the data of intersection traffic signal, traffic volume, vehicle speed and road parameters are obtained through field investigation. Secondly, based on the requirements of occlusion judgment, the simulation needs to output simulation time, vehicle coordinates and other data. Thirdly, according to the geometrical relationship between vehicle and traffic sign, the beginning counting, ending counting and judging conditions of occlusion are determined. Finally, according to the data obtained from the VISSIM simulation experiment, the failure probability analysis of traffic sign occlusion is carried out. The results of the study show that the failure probability of traffic sign occlusion under the original data is 0.2432. Under the condition of constant vehicle speed and green signal ratio in the intersection lane, increasing the number of large vehicles and traffic volume in the lane will increase the probability of traffic sign failure, and the two influencing factors are positively correlated with the probability of traffic sign failure..

keywords: urban arterial intersection; cantilever traffic sign; VISSIM; occlusion failure

作者简介：裴玉龙，东北林业大学交通学院，yulongp@263.net。

Visual Characteristics of Bus Drivers at Road Signalized Intersections Based on Simulation

Pan Fuquan , Wang Zheng , Zhang Lixia , Yan Shiyuan , Ma Changxi , Yang Jinshun
Qingdao Technological University Qingdao University of Technology Qingdao University of Technology Qingdao University of Technology Lanzhou Jiaotong University Qingdao University of Technology

Abstract: Drivers mainly rely on vision to obtain road traffic information in the process of driving. The visual characteristics of bus drivers are very important to the safety of bus operation. In order to explore the mechanism of drivers' visual characteristics affected by signal changes and vehicle interference at signalized intersections, a human environment synchronization platform consisting of simulated driving device, simulation scene, display screen and eye-tracking apparatus was built. UC-Winroad software was used to construct a virtual road traffic scene that was consistent with the actual road. Representative visual characteristics indexes such as eyelid closure, blink duration, blink frequency, fixation point position and number of bus drivers are collected under interference conditions and non-interference conditions, and the data are processed by statistical analysis method. The visual characteristics of bus drivers at signalized intersections are obtained. The results showed that under the condition of front vehicle interference, the eyelid closure decreesed while the number of fixation points increased, the distribution of fixation points includes the cars in front and the change of signal lights and the blink duration is longer when drivers pass intersections with green signal than with red signal. Whether there is front vehicle interference or not, the blink frequency decreases significantly when drivers pass intersections with green signal than red signal.

Key words: signalized intersections; bus driver; visual characteristics; simulation experiment

基于驾纹特征的驾驶行为研究进展与展望

肖逸影，孙一帆，张晖
（武汉理工大学）

摘　要：危险驾驶行为的普遍性及其危害性，一直以来都对道路交通安全构成严重威胁。但由于个体差异性的存在，导致危险驾驶状态的识别精度不高，从而无法进行准确的危险预警。因此，考虑驾驶人个体差异性成为研究热点。基于近年来国内外相关的研究成果，本文从考虑驾纹特征的驾驶行为建模研究、驾驶人个体差异表现及定量研究、利用驾纹特征的驾驶人身份识别及个性化汽车辅助驾驶系统设计四个方面进行总结，最后，分析目前有关驾驶指纹的个体差异性研究的成果及不足之处，提出个性化疲劳状态辨识研究趋势及面对的机遇与挑战。

关键词：交通安全；个体差异；驾驶行为；驾驶指纹

Research Progress and Prospect of Personalized Driving Behavior Study Based on Driving Fingerprint

Xiao Yiying , Sun Yifan , Zhang Hui
（Wuhan University of Technology）

Abstract:

The universality and harmfulness of dangerous driving behavior have always posed a serious threat to road traffic safety. However, due to the existence of individual differences, the recognition accuracy of the fatigue driving state is not high, so that accurate danger warning cannot be performed. Therefore, considering the individual differences of drivers has become a research hotspot. Based on the research results at home and abroad in recent years, this paper studies the driving behavior modeling from the consideration of driving characteristics, individual differences and quantitative research of drivers, driver identification using driving characteristics and personalized car assisted driving system design. In summary, the paper summarizes the results and shortcomings of the current individual differences in driving fingerprints, and proposes the trend of individualized fatigue state identification and the opportunities and challenges.

keywords: traffic safety; individual difference; driving behavior; behavior driving fingerprint

作者简介：肖逸影，武汉理工大学，shadowxyy@outlook.com。

机非混合下不同速度对电动自行车骑行者的视觉影响分析

蒋思婕，沈轩，方琪璐，王卫杰
（南京工业大学交通运输工程学业 南京工业大学 南京工业大学 南京工业大学交通运输工程学院）

摘　要：为探究电动自行车骑行速度的差异对电动自行车骑行者的视觉特性的影响，选取了两条物理环境较为接近但电动自行车骑行速度有较大差异的机非混行路段作为实验路段。采用眼动仪设备分别在白天和夜间实测了不同速度下电动自行车骑行者的眼动数据。结果显示：快速骑行条件下眼跳幅度和眼跳速度低于慢速骑行条件。夜间环境、骑行者的注视点更为集中，且骑行速度的差异对夜间环境骑行者的注视分布影响更大。照明条件的不同会影响骑行者的瞳孔直径变化，但骑行速度不会显著影响骑行者的瞳孔直径变化。

关键词：电动自行车；眼动数据；骑行速度

Effect of Speed Difference on Electric Bicycle Riders' Eye Behaivor with Mixed Traffic

Jiang Sijie , Shen Xuan , Fang Qilu , Wang Weijie
（南京工业大学交通运输工程学业 Nan Jing Tech University Nan Jing Tech University 南京工业大学交通运输工程学院）

Abstract:

This paper aims to explore the effect of speed difference on electric bicycle riders' vision , two aircraft-non-mixed roads with similar physical environment but different speed of electric bicycle were selected as experimental sections. Eye movement data of electric bicycle riders were measured by eye tracker during daytime and night, respectively. The result shows that saccade amplitude and speed were lower in fast riding than slow riding and rider's fixtion is more concentrated in night, different lighting conditions will affect the change of the rider's pupil diameter but riding speed will not significantly affect the change of the pedestrian's pupil diameter.

keywords: E-bike; eye movement data; riding speed

作者简介：蒋思婕，南京工业大学交通运输工程学业，1483342948@qq. com。

Research on Maintenance Cycle Technology of Urban Hybrid Electric Bus

Li Ruxue (China)
长安大学
1254594272@qq.com

Han Wanli (China)
长安大学
593596511@qq.com

Abstract: This paper takes the maintenance cycle technology of urban hybrid bus as the research object. Firstly, an analysis is performed on the current situation of new energy vehicles as well as problems it has caused for vehicle maintenance. The significance of optimizing the mileage based maintenance schedule for hybrid electric buses is expounded by referring to the evolution of national regulations and industrial standards at home and abroad in relation to city bus maintenance. Secondly, it studies the factors affecting the technical status and the regularity of distribution, and draws its changing rules. Finally, on the basis of analyzing and processing the fault data, the mileage of the first-level maintenance cycle of the urban hybrid bus will be determined aiming at economy. By analyzing the relationship among vehicle maintenance, minor repairs and man-hour cost within its running mileage, we can study and determine the mileage of the vehicle's first-level maintenance cycle using confidence analysis and linear regression analysis.

The study accesses 40 HIGER gas-electric hybrid buses (HIGER KLQ6129GCHEV1A), being 12 meters in length each, collecting 937 on-site failure datas during the 12-month span of time and statistically processed according to relevant principles.

Key words: Traffic engineering; Urban hybrid electric bus; Maintenance cycle mileage; Safety; Economy

基于用户视角的纯电动公交车性能测试方法及应用

李成，叶磊，白崎，崔里宁，于海洋

（交通运输部科学研究院 重庆车辆检测研究院有限公司 中国公路学会客车分会 中国道路运输协会城市客运分会 交通运输部科学研究院）

摘　要：本文针对纯电动公交车公告性能数据与用户感受存在较大差距的问题，基于公交企业运营视角，提出能耗、续驶里程、动力性、噪声四项指标的测试方法，并在接近实际运营场景的测试环境下，选取不同车辆生产企业的 10 款车型进行了测试与分析。结果表明：能耗和续驶里程的测试结果与基于等速法的工信部公告值确实有较大差距，测试值与公告值之比的均值分别高达 167%和 61.7%，且差距程度在不同车型间有较大差异。研究成果可为公交企业客观认识纯电动公交车运营性能提供依据，可为完善法规测试方法提供参考，进而促进纯电动公交车推广应用效果。

关键词：电动公交车；车辆性能；运营；测试；能耗

Study on the Performance Test Method and Application of Pure Electric Bus from User's Perspective

Li Cheng , Ye Lei , Bai Xiao , Cui Lining , Yu Haiyang

（China Academy of Transportation Sciences Chongqing Vehicle Test & Research Institute Co.,Ltd. 中国公路学会客车分会 中国道路运输协会城市客运分会 China Academy of Transportation Sciences）

Abstract:

This paper proposes new test methods of the performance of electric buses including four indicators, energy consumption, driving range, power and noise. Then 10 models from different bus manufacturers are analyzed by the sample test data. The results show that both the energy consumption and the driving range have large gaps between the sample value and the nominal value tested by the standard constant velocity method. The average radios of sample value to nominal value are 167% and 61.7% respectively, and the gaps vary obviously between different models. The study can help bus companies to better understanding the products and making more rational choices, then urging manufactures to improve the technical level of electric buses.

keywords: pure electric bus; technical performance; operation; test procedure; energy consumption

作者简介：李成，交通运输部科学研究院，1258571665@qq.com。

上海新能源小客车跟踪研究及精细化管理政策建议

葛王琦，邵丹，陈俊彦
（上海市城乡建设和交通发展研究院）

摘　要：上海新能源汽车持续快速发展，截止 2018 年底，推广总规模已累计达到 23.7 万辆，从用户类型来看，私人领域购车占比超过 60%，已经成为本市小客车增量的重要组成部分。本研究通过对本市新能源汽车快速发展的动因分析，并利用市新能源汽车公共数据采集与监测研究中心的大数据平台进行使用特征分析、挖掘，重点分析了新能源小客车的出行强度、夜间停放分布、出行时辰分布以及充电习惯等使用特征。基于新能源汽车的结构特点和使用特征分析的基础上，提出了新能源小客车作为个体机动化出行方式也应遵循小客车“双控政策”管理的基本思路，从新能源小客车与城市交通的协同发展、精细化使用管理以及对于新技术、新模式的发展方向等方面提出了政策建议。

关键词：新能源小客车；跟踪分析；精细化管理政策；大数据分析

Shanghai New Energy Passenger Vehicle Tracking Study and Fine Management Policy Recommendations

Ge Wangqi , Shao Dan , Chen Junyan
（Shanghai Urban-Rural Construction and Transportation Development Research Institute）

Abstract:

Shanghai's new energy vehicles continue to develop rapidly. By the end of 2018, the total scale of the new energy vehicles has reached 237,000. From the perspective of user types, private-sector purchases account for more than 60%, which has become an important part of the city's small passenger car increment. This study analyzes the motivation of the rapid development of new energy vehicles in this city, and uses the big data platform of the New Energy Vehicle Public Data Collection and Monitoring Research Center to analyze and explore the use characteristics, focusing on the travel intensity of new energy passenger cars and nighttime. Use characteristics such as parking distribution, travel time distribution, and charging habits. Based on the analysis of the structural characteristics and usage characteristics of new energy vehicles, it is proposed that the new energy passenger car as the individual motorized travel mode should also follow the basic idea of the "double control policy" management of the small passenger car, from the new energy passenger car and urban traffic. Collaborative development, refined use management, and policy recommendations for new technologies and new models are proposed.

keywords: New Energy Passenger Vehicle; Refined Management Policy; Big Data Analysis; Tracking Analysis

作者简介：葛王琦，上海市城乡建设和交通发展研究院，gewangqi@163.com。

基于 SWOT 的区域禁售燃油汽车可行性分析与实施路径研究——以西部某省会城市 A 市为例

陈跃，余艳春
（交通运输部公路科学研究院）

摘　要：近期，在国际应对气候变化与低碳发展浪潮下，包括我国海南省在内的多个国家和地区相继提出禁售燃油汽车，并发布了相应时间表或推进计划。禁售燃油汽车将对区域经济和产业发展产生深远影响，必须超前谋划，并结合区域发展实际审慎地开展顶层设计。以西部某省会城市 A 市为例，利用 SWOT 分析技术，深入分析了在 A 市实施禁售燃油汽车面临的优势与劣势、机遇与挑战，结果表明未来在 A 市实施禁售是总体可行的。在此基础上研究、设计了分领域、差异化的实施路径和推进时间表，进一步提出了具体推进措施。本文的研究将为我国其他地区开展禁售燃油汽车的相关政策研究提供重要参考。

关键词：禁售燃油车；可行性分析；实施路径；态势分析法

Feasibility Analysis and Implementation Path of Banning Sales of Fuel Vehicles in a Specific Region Based on SWOT-Taking a City(a Provincial Capital City in the Western Part of China) as an Example

Chen Yue , Yu Yanchun
（Research Institute of Highway Ministry of Transport）

Abstract:

In recent years, as the waves of international response to climate change and low-carbon development, banning sales of fuel vehicles and its schedule or concrete plan have been put forward by many countries and regions including Hainan province in China. The banning sales of fuel vehicles will have far-reaching consequences on regional economic and industries development, thus which must be conducted the top design in advance according to the regional development reality. Taking A city (a provincial capital city in the western part of China) as an example, the strengths, weaknesses, opportunities and threats of banning sales of fuel vehicles in the city are analyzed thoroughly by SWOT, which shows that the banning in A city will be generally feasible in future. On this basis, differential implementation paths and schedules for diverse transportation areas in A city are designed, and concrete measures are further proposed. This study will provide important references for policy researches on banning sales of fuel vehicles in other regions.

keywords: banning sales of fuel vehicles; feasibility analysis; implementation path; SWOT

作者简介：陈跃，交通运输部公路科学研究院，chenyue2014cy@163.com。

促进“交通网”与“新能源网”融合发展的思考

孙可朝，尚晋平，王显光，刘振国，王楠楠
（交通运输部科学研究院）

摘　要：党的十九大提出交通强国发展战略，绿色发展是交通强国建设的必然要求，“交通网”与“新能源网”深度融合将成为交通运输发展的主要趋势。本文重点对公路网、水运网和新能源网融合发展情况进行分析。交通网发展现状方面，分析了我国包括普通国道和国家高速在内的公路网发展现状，分析了包括高等级航道网、港口布局以及港口岸电布局在内的水运网发展现状。从车辆销售、充电桩建设、智慧平台和港口岸电布局等方面，分析了“新能源网”在交通运输领域应用现状。从协调发展、绿色交通和智慧交通的角度，分析了两网融合发展的未来需求。最后，分别从顶层设计、试点示范、标准制定、指数发布等方面提出了两网融合发展的建议.

关键词：交通网;新能源网;融合发展;政策建议

Research on Promoting the Integration and Development of “Traffic Network” and “New Energy Network”

Sun Kechao , Shang Jinping , Wang Xianguang , Liu Zhenguo , Wang Nannan
（China Academy of Transportation Sciences）

Abstract:

The Nineteenth National Congress of the Communist Party put forward Traffic Development Strategy（TDS）, green development is an inevitable requirement for TDS. The deep integration of Transportation Network(TN) and New Energy Network(NEN) would become the main trend in the future. This article focused on the analysis of the integration development of Road Network, Water Transportation Network with NEN. About the status of TN, it analyzed the status of road networks including common national highways and national highways, and the status of water transport networks including high-grade channel networks, port layouts, and the layout of ports and electricity. From the aspects of vehicle sales, construction of charging piles, smart platforms, and layout of ports and electricity, it analyzed the application status of NEN in the field of TN. From the perspective of coordinated development, green transportation, and smart transportation, it analyzed the needs between the TN and NEN in future. Finally, the suggestions for the development of two-network integration were proposed from Top-level design, pilot demonstration, the formulation of standards and the release of indexes.

keywords: Transportation Network; New Energy Network; Integration; Suggestion

作者简介：孙可朝，交通运输部科学研究院，sunkechao2004@163. com。

城市区域电动汽车充电设施配置优化设计

许刘晓，王美佳，尚夏，章立辉
（浙江大学）

摘　要：电动汽车的产销量和市场占有率不断提高，其配建基础设施的设置问题也越来越受到重视。现有充电设施的设计布局缺乏科学、系统的设计方案，导致充电设施利用效率普遍偏低，对电动汽车产业的发展造成了一定阻碍。基于此背景，本文从用户充电需求出发，综合考虑公共充电设施与私人充电设施特性，采用 logit 模型模拟充电设施选择行为，建立充电设施网络配置优化模型，为城市路网中的充电设施设置提供相应依据与方案。

关键词：电动汽车；充电设施；logit 模型；优化设计

Configurations of Electric Vehicle Charging Facilities in Urban Areas

Xu Liuxiao , Wang Meijia , Shang Xia , Zhang Lihui
（Zhejiang University）

Abstract:

The market share of electric vehicles has been increasing across the world, and more and more attention has been paid to the allocation and construction of charging infrastructure. Currently, the existing charging facilities, in many cities, are in lack of scientific and systematic design, which leads to low utilization of charging facilities and hinders the development of electric vehicle industry. Considering the characteristics of public charging facilities and private charging facilities, this paper adopts a logit model to capture users' charging behavior and build a nonlinear program to optimize the configurations of charging facilities in urban areas. Numerical examples based on a real network are carried out to demonstrate our approach.

keywords: electric vehicle; charging facilities; logit model; optimization

作者简介：许刘晓，浙江大学，914711290@qq.com。

多专业协同的精细化低影响道路设计研究

吴才锐，许炎，王涛
（江苏省城市规划设计研究院）

摘　要：城市道路作为城市多功能空间的载体，是高品质城市建设的要素之一。城市道路设计不仅包含了道路工程设计，还包括市政工程和景观工程等。从传统城市道路设计的实际情况来看，只对机动车相关的交通需求进行考虑，缺乏城市视野的多功能空间需求，难以满足人的主体需求。本文首先针对传统道路设计方法进行了反思，进而探索了基于多专业协同的精细化道路设计考量要素。以宁德市滨海大道为例，从空间功能、交通功能、景观功能和市政功能四个方面系统分析了多专业融合的精细化道路设计技术思路。

关键词：道路设计；多专业融合；精细化设计；低影响开发

Research on Refined Low Impact Road Design with Multi-Professional Collaboration

Wu Cairui , Xu Yan , Wang Tao
（Jiangsu Institute of Urban Planning and Design）

Abstract:

As a carrier of urban multi-functional space, urban roads are one of the elements of high-quality urban construction. Urban road design includes not only road engineering design, but also municipal engineering and landscape engineering. From the actual situation of traditional urban road design, only the traffic demand related to motor vehicles is considered, and the lack of multi-functional space demand of urban vision is difficult to meet the main needs of people. This paper first rethinks the traditional road design method, and then explores the elements of the refined road design consideration based on multi-disciplinary collaboration. Taking Ningde City Binhai Avenue as an example, the paper analyzes the technical roadmap of multi-disciplinary and refined road design from four aspects: space function, traffic function, landscape function and municipal function.

keywords: road design; multi-professional integration; refined design; low impact development

作者简介：吴才锐，江苏省城市规划设计研究院，335325430@qq.com。

基于归一化谱熵探索道路工程对冻土的热影响

张宏，张驰，张敏

（长安大学）

摘　要：多年冻土的地温较低，其热稳定性是地质水文循环、能量交换和气候调节的关键。然而，增加的道路工程建设和运营活动正在影响着多年冻土区域的热稳定性，导致多年冻土不断退化，环境问题越来越严重。为了解人类工程活动对多年冻土区热稳定性的时空影响，本研究选择有多条道路相交的青藏高原鄂拉山口地区作为研究区域，并基于归一化谱熵计算了该区域 2000 年至 2018 年地温的紊乱程度，进一步分析了道路缓冲区内不同土地利用类和不同高程的熵值的变化规律。研究结果表明：道路等级和运营时间是影响多年冻土区域热稳定性的重要因素，高速公路对多年冻土区热稳定性的影响高于省道和县道，新建高速公路的热影响与海拔高度正相关，已建高速公路的热影响与植被稀疏的区域正相关。本研究为了解工程活动对多年冻土区域地温的时空影响提供了一种创新的方法，从而帮助更好地规划基础设施项目，避免对环境脆弱地区的破坏。本研究呼吁采取先进的道路养护技术，以减少道路运营对多年冻土区域的累积扰动。

关键词：熵；热影响；青藏高原；道路建设；多年冻土

Exploring Thermal Impact of Roads on Permafrost Using Normalized Spectral Entropy

Zhang Hong , Zhang Chi , Zhang Min

（Chang'an University）

Abstract:

Permafrost is characterized by low temperature, whose thermal stability is key to geohydrological cycles, energy exchange, and climate regulation. Nonetheless, increasing engineering activities, road construction and operation, are affecting the thermal stability in permafrost regions and has already led to the degradation of permafrost and related environmental problems. To understand the spatiotemporal influence of human engineering activities on the thermal dynamics in permafrost regions, we placed the study in Ela Mountain Pass with multiple road intersected on Qinghai-Tibet Plateau and calculated the thermal dynamics from 2000 to 2017 using a powerful index – normalized spectral entropy (measuring the disorderliness of time series data). Our results indicate road level and operation duration are significant affecting factors, where expressway exhibit stronger thermal impacts than province-level road and county-level road, the thermal impacts of newly paved expressway is positively related to elevation, while the thermal impacts of old expressway is positively related to less vegetated area. The study provides an excellent method to understand the spatiotemporal impacts of engineering activities on the temperature dynamics in permafrost regions, thereby helping policymakers in China and many other

countries to better plan their infrastructure project, so as to avoid environmentally vulnerable regions. The study also calls for advanced technique in road maintenance, which can reduce the accumulated disturbance of road operation on permafrost regions.

keywords: entropy; thermal impact; Qinghai-Tibet Plateau; road construction; permafrost

作者简介：张宏，长安大学，1191080464@qq.com。

高速公路扬尘污染防治措施的分析研究

郑元福
（天津市高速公路管理处）

摘　要：对现行高速公路扬尘污染防治措施进行了介绍，并分析、研究了扬尘污染防治措施在实际实施中存在的一些难点。结合高速公路相关各类工程施工中扬尘污染防治的工作特点，提出了几点治理扬尘污染的设想、建议，意在探索一些更高效，更实用的高速公路扬尘污染防治措施。

关键词：高速公路；扬尘污染；养护工程；涉路施工

Analysis and Research on Prevention and Control Measures of Dust Pollution on Expressway

Zheng Yuanfu
（天津市高速公路管理处）

Abstract:

Introduces the current prevention and control measures of flying dust pollution on expressway, and analyses and studies some difficulties existing in the actual implementation of the prevention and control measures of flying dust pollution. Combining with the characteristics of dust pollution prevention and control in Expressway construction, this paper puts forward some ideas and suggestions for dust pollution control, aiming at exploring some more efficient and practical measures for dust pollution prevention and control of expressway.

keywords: expressway; dust pollution; maintenance engineering; construction

作者简介：郑元福，天津市高速公路管理处，zhengyufor@163.com。

An Experiment Study on Eco-Driving Style Acceleration During Queue Discharge at Urban Signalised Intersections

Qian Gongbin
苏交科集团股份有限公司
gongbinqian@gmail.com

Edward Chung
苏交科集团股份有限公司

Abstract: Eco-driving has gained increasing attention for its fuel saving benefits. However, the prevailing eco-driving studies focus mainly on its impacts on individual vehicles but not the entire traffic flow performance. In practice, an eco-driver who has changed driving behaviour can potentially impede nearby drivers' operation. This study explores the impacts of eco-driving on queue discharge performance at urban signalised intersections where fuel economy is of crucial importance. The investigation is based on a field experiment which was conducted in the Shirosato Driving Test Centre in Japan. It is found that eco-driving style acceleration is beneficial to reduce individual vehicles' fuel consumption, whereas the performances of the entire platoon were affected by various factors. The discussion based on the experiment study is useful for future investigation of eco-driving with traffic flow consideration.

Key words: eco-driving; fuel consumption; queue discharge; driving behaviours

Commuter Exposure to Particulate Matter in Urban Public Transportation of Xi'an, China

Cao Huihui (China)
长安大学
1432082419@qq.com

Abstract: To investigate commuter exposures to particulate matter (PM) in urban public transportation transit and subway commuting, PM concentrations are simultaneously monitored for subway and buses on the same routes in Xi'an，China. The micro-environments variability of each stage in the total trip is discussed. Exposure doses of the different commute process are estimated with the heart rates of the volunteers. Experimental measurements were performed during traffic peak hours in July and October (summer/autumn) on the two typical commute routes for a total of 36 trips. One-way ANOVA was used to analyze the effects of different variables on commuter exposure. On the same route, the average PM exposure concentration of bus commuters is higher than subway commuters'. For example, on Route 1 in case study, the average PM10, PM2.5, and PM1 exposure concentrations of bus commuters were 71.6%, 19%, and 10.4% higher than those of subway commuters, respectively. In the ground transportation mode, the exposure concentration of bus commuters is affected by the type of vehicle. Particle concentrations were significantly higher inside compressed natural gas (CNG) bus compared to the pure electric (PE) bus, and especially in summer, PM10 concentration in CNG bus is 4.3 times higher than that in PE bus. In CNG bus, commuters in the back door area have the highest PM10 exposure concentration (179.6 μg/m3), followed by the rear of the carriage (142.8μg/m3), and finally the front door (105.4μg/m3).Stay away from ground traffic sources, effective ventilation systems, and the use of screens in subway systems have contributed to the lower exposure of subway commuters. For each mode of transportation in our study, hot spots exposed to particulate matter appear in the waiting period.

Key words: commuting exposure; Traffic micro-environment; bus; subway; PM concentration; inhaled dose

基于联立方程的骑行行为特性研究

封少帅，李聪颖

（西安建筑科技大学）

摘　要：为了探究自行车骑行过程中的骑行行为产生规律，选取典型的自行车路段进行道路状况和骑行行为的调查与数据收集，分析影响骑行行为的因素。以调查数据为基础，应用联立方程建立自行车占道、避让和逆行骑行行为模型。研究结果表明：物理设施环境、混合交通情况、交通运行情况对骑行行为有影响。道路等级、非机动车道宽度、机非隔离形式、人非隔离形式对占道行为的产生影响较大，其相关系数绝对值都是大于 1。道路等级、非机动车道宽度、周边土地利用性质、非机动车道是否平整、人非隔离形式对避让行为的产生有影响较大，其相关系数绝对值都大于 5。道路等级、周边土地利用性质、非机动车道是否平整、人非隔离形式、是否有公交出入对逆行行为的产生影响较大，它们的影响相关系数绝对值都大于 1。研究建立的骑行行为模型对自行车服务水平评价、骑行设施精细化、骑行安全以及自行车骑行系统的合理规划具有参考意义。

关键词：骑行行为；联立方程

Research on Bicycle Behavior Characteristics Based on Simultaneous Equations

Feng Shaoshuai , Li Congying

（Xi'an University of Architecture and Technology）

Abstract:

In order to explore the law of riding behavior during cycling, select typical bicycle sections for survey and data collection of road conditions and riding behaviors, and analyze the factors affecting riding behavior. Based on the survey data, the simultaneous equations were used to establish a model of bicycle occupation, avoidance and retrograde riding behavior. The research results show that the physical facility environment, mixed traffic conditions, and traffic conditions have an impact on riding behavior. Road grade, non-motor vehicle lane width, machine non-isolated form, and non-isolated form of people have a greater impact on the behavior of the road. The absolute value of the correlation coefficient is greater than 1. Road grade, non-motor vehicle lane width, surrounding land use nature, non-motor vehicle lanes are flat, and non-isolated forms have a greater impact on the avoidance behavior, and the absolute value of the correlation coefficient is greater than 5. The road grade, the nature of surrounding land use, the non-motor vehicle lanes are flat, the non-isolated forms of people, and whether there is public transport has a greater impact on retrograde behavior, and their absolute correlation coefficient is greater than 1. The riding behavior model established by the research has reference significance for the evaluation ofbicycle service level, the refinement of

riding facilities, the safety of riding and the reasonable planning of the bicycle riding system.

keywords: cycling behavior; simultaneous equation

作者简介：封少帅，西安建筑科技大学，1440426502@qq.com。

考虑环境成本的街区制小区限速研究

张玉，王晓宁
（哈尔滨工业大学）

摘　要：街区制小区的实施能够在一定程度上缓解交通拥堵，但也会对小区环境产生较大影响。从汽车尾气污染和交通噪声两方面，分析小区道路开放对环境的影响。选取 CO、HC、NOX 计算污染物排放量，建立汽车尾气成本模型；通过确定小区 50dB 以上噪声的影响范围，建立交通噪声成本模型。综合考虑环境成本、路网运行效率，构建街区制路网系统成本模型，以系统成本最低为目标确定街区制小区限速值。以哈尔滨欧洲新城小区为例，以 5km/h 为限速调整值，取 15km/h、20km/h、25km/h、30km/h、35km/h 五种限速值，根据小区开放方案，运用街区制路网系统成本模型，进行不同限速值下的成本计算，得到系统成本最低的限速值为 20km/h。

关键词：街区制小区；汽车尾气；交通噪声；系统成本模型；限速值

Research on Speed Limit of Block System in Consideration of Environmental Cost

Zhang Yu , Wang Xiaoning
（Harbin Institute of Technology）

Abstract:

The block system can alleviate traffic congestion to a certain degree, but it will also have a greater impact on the community environment. This paper analyzes the impact of community road opening on the environment from two aspects: automobile exhaust pollution and traffic noise. Calculating pollutant emissions by selecting major pollutants such as CO, HC and NOX, and then establishing a vehicle exhaust cost model. Establishing a traffic noise cost model by determining the influence range of noise above 50dB in the cell. By considering the environmental cost and road network operation efficiency comprehensively, the cost model of the street road network system is constructed for the purpose of the lowest cost in the system. The speed limit value of the block system is determined. Taking Harbin European New Town Community as an example, this paper takes five speed limit values of 15km/h, 20km/h, 25km/h, 30km/h, and 35km/h, and then calculates the cost under different speed limits according to the community open plan by using the street road network system cost model. The final lowest system speed limit is 20km/h.

keywords: automobile exhaust; traffic noise; system cost model; speed limit; block community

作者简介：张玉，哈尔滨工业大学，476690946@qq.com。

上海机动车排放实时动态测算模型构建机制

葛王琦，郑凌瀚，朱洪，薛美根
（上海市城乡建设和交通发展研究院）

摘　要：上海市交通研究机构与环境研究机构在静态机动车排放模型合作构建的基础上，进一步在构建、验证和应用等环节深化合作。在综合道路交通模型的基础上，融合运用全市1500余个快速路断面线圈、5000余个地面交叉口SCATS线圈、8万余个发布段车速信息，实现了全市交通路网9万余条路段link上每隔30分钟的机动车污染物排放实时测算和动态展示，并为首届中国进口博览会期间的大气环境保障工作提供了重要的技术支撑。

关键词：交通环境治理；机动车排放模型；动态实时

Construction Mechanism of Shanghai Vehicle Emission Real-Time Dynamic Model

Ge Wangqi , Zheng Linghan , Zhu Hong , Xue Meigen
（Shanghai Urban-Rural Construction and Transportation Development Research Institute）

Abstract:

On the basis of the cooperation of the static vehicle emission model, transportation institute and environmental institute at Shanghai have a further cooperation in the aspects of construction, verification and application of the dynamic vehicle emission model. Based on the comprehensive road traffic model, we use more than 1,500 fast road section coils, more than 5,000 Sydney Coordinated Adaptive Traffic System coils at intersections, and more than 80,000 release section speed information to realize more than real-time calculation and dynamic display for vehicle pollutant emissions every 30 minutes of 90,000 links of the city's road traffic network. The model provided important technical support for the atmospheric environmental protection task during the first China International Import Expo.

keywords: Traffic Environment Governance; Vehicle Emission Model; Dynamic; Real-time

作者简介：葛王琦，上海市城乡建设和交通发展研究院，gewangqi@163.com。

Analysis of Pollutant Distribution Based on Taxi Travel Volume: A Case Comparison of Xi'an and Ningbo, China

Sun Xiaoke (China)
长安大学
908592953@qq.com

Chen Hong (China)
长安大学
glch@chd.edu.cn

Luo Ting (China)
长安大学
luo_oting@qq.com

Abstract: With rapid social and economic development, the amount of traffic in China has gradually increased, so as the traffic-generated pollution, which has caused serious influence to the environment and the public health. In this paper, Xi'an, a typical city in the northwest China, and Ningbo, another typical in the southeast, have been selected to analyze the impact of traffic on environmental pollution to solve environmental problems. In the analysis, the GPS taxi data and pollutant concentration data of national environmental monitoring points of 7 days in Xi'an and Ningbo are used respectively. Spatial-temporal characteristics and the high and low value cluster analysis of the taxi data and pollutant concentration are carried out using spatial interpolation, kernel density analysis, and clustering. The results show that the peak of taxis data coincides with the extremely high concentration of 6 pollutants. The concentration of the pollutants reaches peak level at 9 o'clock, and begins to drop sharply at 12 o'clock. The ozone has an opposite trend with other pollutants, which may be related to the concentration of nitrogen oxides and have a titration effect on the ozone. The hotspot areas of taxi data are highly coincident with the spatial distribution of pollutants, which mainly locate in Xi'an and Ningbo downtown areas. The taxi data and pollutant data have high similarity in the high and low value clustering results. In addition, it has been found that the traffic restriction policy has a certain effect on reducing pollutant concentration. And the study also shows that corresponding pollutant concentration in Xi'an is significantly higher than that in Ningbo, which has a great relationship with the population, economy, climate and travel habits of the two regions. Therefore strengthened management on traffic restrictions, purchase restrictions as well as traffic in Xi'an is advocated. Altogether, this study may provide technical support to the relevant decision making.

Key words: taxi; traffic volume; pollutants; spatial-temporal characteristics

Research on Roads with Low Noise Pavement

Ran Deqin (China)
山东省交通科学研究院
randeqin@126.com

Abstract: Roads with low noise pavement have attracted more and more attention in recent years. Construction of low-noise road is an important way to reduce road outside-car traffic noise. Because many roads are rebuilt now, there is no pavement with low noise when initially laid. With the gradual improvement of life quality, it is imperative to reduce the pavement noise. The road pavement reconstruction should use low noise road pavement as much as possible. The scope of the current paper was to briefly review literature on different kinds of roads with low noise pavement. It will be conducive to further application of low noise pavement in the future. According to the literature, the future researches on roads with low noise pavement should include: (1)Studies on porous asphalt pavement, dense asphalt rubber pavement, SMA pavement, ultra-thin friction course and porous elastic road surface comparing to dense asphalt concrete pavement; (2)Studies on the noise reduction mechanisms and performance of the pavements.

Key words: reducing noise; low noise pavement; road; asphalt pavement; cement concrete pavement

车辆碳排放与高速公路交通流关系的研究

董亚萍，许金良
（长安大学公路学院）

摘　要：高速公路交通流状态对车辆碳排放有很大的影响。为了探究交通流状态与车辆碳排放之间的关系，本研究开展了不同交通流状态下的碳排放实地试验，获取了瞬时速度、油耗和交通量数据，然后根据 IPCC 间接碳排放核算方法得到了碳排放数据，分析了不同交通流状态下的碳排放规律，以 v/C 为自变量分别建立了载重车和小客车的碳排放预测模型。研究表明，拥堵流状态碳排放量最多，其次是不稳定流、自由流、稳定流。碳排放与 v/C 呈三次曲线函数的关系。当 v/C 在 0.4~0.5 范围内时，载重车和小客车的碳排放最小。本研究建立的碳排放模型可以实现对不同交通流状态下车辆碳排放的量化。本研究的相关结论对低碳运营管理和低碳改扩建等工作具有重要的参考意义。

关键词：碳排放；交通流状态；v/C；预测模型；高速公路

Carbon Emissions in Different Traffic Flow Patterns of Expressways

Dong Yaping , Xu Jinliang
（Chang'an University）

Abstract:

Highway traffic flow patterns have a large impact on carbon emissions of vehicle. In order to explore the relationship between traffic flow patterns and vehicle carbon emissions, this study carried out a field test to obtained fuel consumption and traffic volume data under different traffic flow patterns, and carbon emission data is obtained through IPCC indirect carbon emission accounting method. The carbon emission prediction models for diesel truck and gasoline passenger cars were established respectively with v/C as an explanatory variable. The results shown that carbon emissions in congested flow condition are the highest, followed by unstable flow, free flow and steady flow. The relationship between v/C and carbon emission is a cubic curve function. Carbon emissions of truck and passenger car with v/C of 0.4 to 0.5 are the smallest. The carbon emissions models can quantify the carbon emissions of vehicles under different traffic flow patterns. This study provided herein as a data support and reference basis for expressway operation management, expressway reconstruction and expansion work following the concept of low carbon environmental protection.

keywords: carbon emissions; traffic flow patterns; v/C; prediction model; expressway

作者简介：董亚萍，长安大学公路学院，yapingdong@chd.edu.cn。

港珠澳大桥雷电防护技术探讨

乔梅梅，哈元元，李永亮
（北京交科公路勘察设计研究院有限公司）

摘　要：本文针对港珠澳大桥特大型工程的雷电防护技术，结合大桥自身的结构特点，从大桥防雷类别的确定、直击雷防护、侧击雷防护、等电位连接、接地系统、机电设备雷电防护等方面详细阐述了珠港澳大桥雷电防护设计方案。

关键词：港珠澳大桥

Discussion of Lightning Protection Technologies in Zhuhai-Hong Kong-Macao Bridge

Qiao Meimei , Ha Yuanyuan , Li Yongliang
（北京交科公路勘察设计研究院有限公司）

Abstract:

The lightning protection technologies, which are essential to super large-scale engineering project like Zhuhai-Hong Kong-Macao Bridge, are discussed in the paper. Based on the structure characteristics of, the lightning protection design of Zhuhai-Hong Kong-Macao Bridge is introduced in detail, which includes identifying the level of lightning protection, direct lightning protection, flank lightning protection, equipotential bonding, power grounding systems and mechanical and electrical equipment lightning protection.

keywords: Zhuhai-Hong Kong-Macao Bridge

作者简介：乔梅梅，北京交科公路勘察设计研究院有限公司，231707038@qq.com。

浅析旅游公路景观设计要点及创新成果研究——以环巢湖旅游大道为例

马婧，单文胜
（安徽省交通规划设计研究总院股份有限公司）

摘　要：旅游公路是兼具交通与旅游双重功能的公路，它是集自然属性和社会属性、功能性和观赏性、实用性与艺术性于一体的景观综合体。随着经济的不断发展，人们对出行品质要求不断提高，旅游公路作为连接城市及景区间的通道，它的建设不仅仅有安全、迅速、经济方面的需求，而且要在景观方面给人以美的享受，同时完善配套设施，将观景台、旅游标志标牌等设施与交通基础设施统一配套设计，以体现地域人文特征及旅游特色。

关键词：旅游公路

Key Points and Innovation Achievements of Tourism Road Landscape Design-A Case Study of Chaohu Tourism Avenue

Ma Jing , Shan Wensheng
（Anhui Transport Consulting & Design Institute Co.,Ltd.）

Abstract:

The tourism road includes transportation and tourism functions. It integrates natural and social attributes, functional and ornamental, practical and artistic. With the development of the economy, people's requirements for travel quality are improving continuously. As the link between the city and the scenic area, the construction of the tourism road should satisfy the needs of safety, efficiency and economy; in particular, it should also provide people with the feeling of enjoyment. Meanwhile, the affiliated facilities such as observation deck and tourism signs in the tourism road should be designed with the other transport facilities, and therefore the regional cultural and tourism characteristics will be reflected.

keywords: Tourist roads

作者简介：马婧，安徽省交通规划设计研究总院股份有限公司，188535035@qq. com。

Air Field Flow and Particle Diffusion in Street Canyon Under the Influence of Viaduct and Solar Radiation

Zhi Huinan
Chang'an University
835797241@qq.com

Abstract: Urban viaduct as a kind of road infrastructures is widely set up to alleviate traffic congestion, but the air pollution caused by it are seldom studied. To investigate the effect of viaduct on particle diffusion below viaduct, field measurements for particulate matter (PM) concentration variety of along roadside with and without viaduct coverage were conducted in this paper. Air flow and particle (PM2.5) distribution around the viaduct were simulated by Computational Fluid Dynamic (CFD) equipped with the Discrete Phase Model (DPM) in Lagrange coordinate system. Experimental results of this case study indicate that the average mass concentrations of PM10 (156.7 μg m−3), PM2.5 (77.3 μg m−3) and PM1 (56.5 μg m−3) on elevated highway exceeded those on the ground-level expressway by 15%, 10% and 12%, respectively. Simulation found that two main vortexes as well as two or three secondary vortexes are generated in the canyon when the viaduct and barrier is added, while only one main vortexe in the street canyon without viaduct covered. Viaduct makes the particulate matter distributed unevenly, and the concentration in the leeward side near the ground is the highest. The vortex center is elevated as the value of ΔT (ΔT is the value of ground-air temperature) increases, but the numbers are basically maintained. We conclude that viaduct increases the concentration of particulate matter in the street canyons and greatly affects the air flow field. The sound barrier on viaduct and ΔT contribute to reduce the PM concentration, but the effect is limited.

Key words: Field experiments; CFD modeling; RNG k-ε turbulence models; Viaduct

陕西省交通运输碳排放灰色关联与预测分析

李营，李晓东，吕欣丽
（长安大学）

摘　要：随着我国社会经济的发展，交通运输领域的碳排放量仍然在持续增长，交通运输碳排放已经成为引起气候变化最主要的消极因素。本文根据陕西省交通运输能量消耗基础数据，运用灰色关联分析法，分析了城市化率、人口数量、GDP、交通运输仓储和邮政业投资额、单位 GDP 能耗、私家车数量这六大因素与陕西省交通运输碳排放关联度，并指出各相关因素对陕西省交通运输碳排放的影响；然后基于灰色系统预测模型 GM(1,1)，对陕西省交通运输电力碳排放进行量化预测。研究结果表明，陕西省交通运输碳排放与相关因素关联度依次是：城市化率>人口数量>GDP>交通运输仓储和邮政业投资额>单位 GDP 能耗>私家车数量。鉴于其研究结果，提出了减少交通运输碳排放的相关措施，为陕西省交通运输碳减排提供参考。

关键词：交通能源；灰色关联分析；GM(1,1)模型；电力碳排放

Grey Correlation and Prediction Analysis of Transportation Carbon Emission in Shanxi Province

Li Ying , Li Xiaodong , Lv Xinli
（Chang'an University）

Abstract:

With the development of China's social economy, carbon emissions in the transportation sector continue to grow. Transportation carbon emission has become the most important negative factor in causing climate change. Based on the basic data of transportation energy consumption in Shaanxi Province, this paper analyzes the urbanization rate, population, GDP, transportation warehousing and postal investment, energy consumption per unit of GDP, and the number of private cars by using gray correlation analysis. Analyze the relationship between these six factors and the carbon emission of transportation in Shaanxi Province. And point out the impact of various related factors on the carbon emission of transportation in Shaanxi Province. Then based on the grey system prediction model GM(1,1), the carbon emissions of transportation power in Shaanxi Province are quantitatively predicted. The results show that the correlation between transportation carbon emission and related factors in Shaanxi Province is: urbanization rate> population> GDP> transportation warehousing and postal investment> energy consumption per unit of GDP > number of private cars. In view of the research results, relevant measures to reduce carbon emissions from transportation are proposed to provide reference for transportation carbon emission reduction in Shaanxi Province.

keywords: transportation energy; grey relational analysis; GM(1,1) model; power carbon emission

作者简介：李营，长安大学，2320395989@qq.com。

面向安全节能的高铁轨道电路调整表的算法改进

田雅洁，王可馨，刘沛岱，杨世武
（北京交通大学）

摘　要：近些年中国高铁迅速发展，总里程占世界的2/3，为保证其安全性，安全可靠地传输能量，国内高铁轨道电路中能量大多留有余量，从而减少外界因素对轨道电路的干扰，减少故障发生。这样的出发角度使高铁的能源消耗不能控制在最低的水平，虽然弱电电路已部分实现节能要求，但随着高铁里程增多，优化节能带来的意义更为深远。我们的研究旨在通过优化高铁轨道电路调整表的部分数据，在高铁安全可靠运行的前提下，减少能量消耗，达到节能的目的，使高铁经济向绿色经济的方向发展。

本文以国内最常用的无绝缘轨道电路ZPW—2000为例，介绍影响无绝缘轨道电路节能的两个因素，对其电路建立四端网络模型，运用数据库建立、Matlab仿真等方法得到线路区段化的节能改进算法，并通过分析实地考察所获数据（D站、L站）进行仿真结果模拟分析，得出保证安全条件下的最优发送电压，相比以经验为依据的原始轨道电路调整表更加绿色节能。

关键词：轨道电路；调整表；数据库；节能；算法；四端网络理论

An Improved Algorithm for the Track Circuit Adjustment Table of High-Speed Railway for Safety and Energy Saving

Tian Yajie , Wang Kexin , Liu Peidai , Yang Shiwu
（Beijing Jiaotong University）

Abstract:

In recent years, the high-speed railway industry of China has developed quickly, with the total mileage accounting for 2/3 all over the world. In order to ensure the safety of high-speed railway and the safe and reliable transmission of energy, the energy in high-speed railway track circuit is mostly reserved, which means the energy used in the track circuit now is far more than it need. People do this so as to reduce the interference of external factors on the track circuit and reduce the occurrence of faults. Such starting angle makes it impossible to control the energy consumption of high-speed railway at the lowest level. Although the weak current circuit has partially realized the energy saving requirements, with the increase of the mileage of high-speed railway, the significance brought by the saving of energy is more profound. Our research aims to optimize part of the data in the adjustment table of high-speed railway track circuit, reduce energy consumption and achieve the purpose of energy saving under the premise of safe and reliable operation of high-speed railway, so as to make high-speed railway industry develop towards the direction of green economy.

In this paper, we take the most commonly used jointless track circuit in China of ZPW-2000 as an example, introduces the two factors that affect the energy-saving of jointless track circuit. We make the four-terminal network model of jointless track circuit, and use the method of database establishment and the Matlab simulation to get the improved algorithm that adjust to different

environment which can achieve the aim of energy saving. Then we use the data we gather in the D and L station of Hebei to simulate and analyse the simulation results. Finally, we get the optimal input voltage under the condition of ensuring safety. With the comparison with the input voltage in the adjustment table of high-speed railway track circuit based on experience, we achieved the goal of energy conservation, which in line with the requirements of the green economy.

keywords: track circuit; adjustment table; database; enegy saving; Algorithm; four-terminal network model

作者简介：田雅洁，北京交通大学，16271083@bjtu.edu.cn。

城市轨道建设工程对道路环境的影响研究

任璐，殷晓潇
（长安大学杂志社 中交一公局公路勘察设计院有限公司）

摘　要：城市轨道建设严重影响着城市道路的交通秩序，其影响时间长、范围广，将施工形式与位置合理分类，研究了不同施工位置对机动车、非机动车、行人、周边环境的影响，为研究施工前后交通流参数变化、施工路段通行能力和交通组织方法提供基础。研究结果表明：不同施工位置对机动车、非机动车、行人、周边环境的影响不同，其中占用道路和交叉口中央的施工对交通流量影响最大。因此，在不同施工阶段应充分研究其对道路交通的影响方式，并合理引导和组织道路交通流，最大程度的保证交通安全，减小交通阻塞。

关键词：城市轨道交通；施工；影响区域；施工占道方式

Implementation Environment and Influence of Urban Rail Construction Project

Ren Lu , Yin Xiaoxiao
（长安大学杂志社 中交一公局公路勘察设计院有限公司）

Abstract:

Urban rail construction seriously affects the urban traffic order, and the influence time is long and the scope is wide. This paper reasonably classifies construction forms and locations, and studies the influences of different construction locations on motor vehicles, non-motor vehicles, pedestrians and the surrounding environment, so as to provide a basis for studying the changes of traffic flow parameters before and after construction, the capacity of construction sections and traffic organization methods. Analysis results show that different construction locations have different impacts on motor vehicles, non-motor vehicles, pedestrians and the surrounding environment, among which the construction occupying the center of road and intersection has the greatest impact on traffic flow. Therefore, in different construction stages, the influence mode on road traffic should be fully studied, and the road traffic flow should be reasonably guided and organized to ensure traffic safety to the greatest extent and reduce traffic congestion.

keywords: urban rail transit; construction; influence area; construction occupation mode

作者简介：任璐，长安大学杂志社，327499759@qq. com。

缺乏关注的雨天换乘——以深圳为例

韦艳莎
（深圳大学）

摘　要：随着社会的发展，人们的出行越来越复杂，交通方式的发展呈现多样化趋势。行人希望出行成本低、高可达性，于是便产生了换乘需求。尽管国内许多大城市为满足行人的换乘需求，在实现不同交通方式之间以及相同交通方式的不同线路的有效衔接上做了许多努力，但关于换乘问题的解决仍旧不尽人意。尤其是在雨天换乘这一方面，目前多数城市的换乘设施中很少有针对雨天等恶劣天气的设计，不仅不符合交通设计的精细化要求，也未能体现交通设计的“以人为本”原则。因此，基于现状换乘设施，从雨天必须出行的行人角度出发，以深圳市为例，对换乘设施中难以实现雨天换乘的问题进行讨论与分析，并提出一些建议。

关键词：交通规划；公共交通；设施设计；雨天换乘

Under-Concerned Transfer on Rainy Days-Take Shenzhen as an Example

Wei Yansha
（Shenzhen University）

Abstract:

With the development of society, the trips of people become increasingly complex, and the traffic modes show a trend of diversification. Pedestrians hope that the travel cost is low and the travel accessibility is good, so the transfer demand is generated. Although many large cities in China have made a lot of efforts to meet the transfer needs of pedestrians and realize the effective connection between different modes of transportation and different routes of the same mode of transportation, the solution to the transfer problem is still unsatisfactory. Especially in the rainy-day transfer, there are few transfer facilities in most cities designed for bad weather, which not only does not meet the refined requirements of traffic design, but also fails to reflect the "people-oriented" principle of traffic design. Therefore, based on the current transfer facilities, counting the perspective of pedestrians who must travel in the rainy days and taking Shenzhen City as an example, this article discusses and analyzes the difficulty of transferring in the transfer facilities, and puts forward some suggestions.

keywords: Traffic Planning; Public Traffic; Facility Design; Transfer

作者简介：韦艳莎，深圳大学，wys_wyz@163.com。

Pedestrian Exposure to Traffic-Related PM2.5, BC and UFP of Adults and Teens a Case Study in Xi'an, China

Qiu Zhaowen
长安大学汽车学院
qzw@chd.edu.cn

Lv Huitao
Chang'an University

Zhang Fan
长安大学汽车学院

Wang Wazi
Chang'an University

Abstract: To evaluate the exposure of adults and teens to fine particles (PM2.5), black carbon (BC), and ultrafine particles (UFP) as they walked along urban roads, an investigation was performed using mobile measurement devices on two types of urban roads (arterial and collector) in Xi'an. The inhalation dose model, considering exposure concentration, inhalation rate, and trip time, was employed to estimate the personal inhaled dose of pollutants for adults and teens. Multivariate linear regression was used to explore impact factors that contributed to their exposure variability. Results showed large spatial and temporal pollutant concentration variations along the designed route. Pedestrians experienced higher exposure concentrations on the arterial road than on the collector road. Teens faced higher PM2.5 and BC inhaled doses than adults on all the streets studied, although sometimes being exposed to lower concentrations than adults. In addition, gender-related inhaled dose differences between adults were more significant than those for teens. The overall background concentrations explained the greatest variability in pollutant exposures, from 18.7% for BC to 40.1% for PM2.5. Ambient concentrations and traffic volume as well as pollution hotspots (pedestrian cigarette smokers, restaurants, and open burning) were identified as major factors affecting the pollutant concentrations.

Key words: pedestrian exposure; traffic-related PM2.5, BC and UFP; inhaled dose; multivariate linear regression; adults and teens

基于 DPSIR 框架的交通运输低碳发展评价及障碍因子分析——以北京市为例

周雅欣，王建伟，高洁，张诗青，宋亚南

（长安大学 长安大学 长安大学 郑州航空工业管理学院 长安大学）

摘　要：以 DPSIR 框架为基础构建交通运输低碳发展评价指标体系，明确各指标之间的因果关系；运用熵权 TOPSIS 模型及障碍度模型对北京市 2007-2017 年间的低碳交通发展水平及因子障碍度进行测算。结果表明，北京市 11 年间低碳交通发展水平由中级迈向良好，年均增长速度约为 8.57%；影响北京市低碳交通发展水平的主要障碍因子是环保财政支出占比、交通运输碳排放强度、运营公交车辆数增长率、客运周转量、公路货物周转量占货物总周转量比重、人口增长率、人均 GDP 和交通运输增加值占 GDP 比例，揭示了低碳交通治理的短板因素，为北京市的交通运输低碳发展政策制定提供决策依据。

关键词：交通运输；低碳发展；DPSIR 框架；熵权 TOPSIS；障碍度

Evaluation and Obstacle Factor Diagnoses of Transport Low Carbon Development Based on DPSIR Framework-A Case Study of Beijing

Zhou Yaxin , Wang Jianwei , Gao Jie , Zhang Shiqing , Song Yanan

（Chang'an University Chang'an University Chang'an Universit 郑州航空工业管理学院 Chang'an University）

Abstract:

Based on the DPSIR framework，the low-carbon transport development assessment indicator system was established to clarify the causal relationship between the indicators．TOPSIS entropy weight model and obstacle degree model were used to calculate the development level and factor obstacle degree of low-carbon transport in Beijing from 2007 to 2017. The results show that the development level of low-carbon transport in Beijing has been improved from the intermediate level to a good level in the past 11 years, with an average annual growth rate of about 8.57%. The main obstacles to the development of low-carbon transport in Beijing are proportion of environmental protection financial expenditure, transport carbon intensity, growth rate of operating bus vehicles, passenger turnover, the proportion of highway freight turnover to total freight turnover, population growth rate, GDP per capita, the value added of transportation, warehousing and postal services as a percentage of GDP. It reveals the shortcoming factors of low-carbon transport governance and provides decision-making basis for the formulation of low-carbon transport development policies in Beijing.

keywords: transport; low carbon development; DPSIR frame; entropy-TOPSIS; obstacle degree

作者简介：周雅欣，长安大学，wo1248212060@163.com。

Factors Affecting Wear of Rubber Particles from Tyres

Di Yun (China)
长安大学
1031655076@qq.com

Abstract： A state-of-the-art review of key parameters that influence measurement and modeling of microplastic from tyre wear. Each year, large amount of tiny rubber plastics are generated due to the wear from tyre tread, and would spread into the environment including the air ,the rivers or the oceans. The current methods of tyre tread rubber wear measurements is questioned and the tire-pavement interaction is discussed. The latest developments on studying the abrasion of tyre wear is summarized, the mechanisms of tyre wear are highlighted. An overview of modeling efforts entailing different aspects of tire wear is also presented. In term of the pavement, the root mean square slope of the surface could increase the rubber wear significantly. For the properties of the tread rubber, the stiffness is very important. The environment temperature, vehicle acceleration and deceleration operations could influence the wear greatly, due to the viscoelastic properties of the tread rubber. There is need for experimentally-validated wear particle prediction models, especially considering the size of the particles. Such models should account for tire and pavement surface texture characteristics, and the influence of environmental factors. Some other research needs are also identified.

Key words： tyre wear; microplastic; contact mechanism; abrasion mechanism; modeling; influencing factors