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磁浮交通与高铁路网融合发展的探索及应用

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摘 要：随着我国新型城镇化战略的推进，亟待解决城市交通、能源和环境等问题。磁浮交通作为轨道交通行业中新生力量，补充和完善了现有轨道交通体系。磁浮交通具有振动噪音小、爬坡能力强、转弯半径小等优势，长沙磁浮快线的探索与实践经验表明，磁浮交通与高铁路网融合发展是必要的也是成功的，建议加快推广应用。

关键词：轨道交通 磁浮交通 磁浮列车悬浮控制 应用前景 融合发展

Exploration and Application of Integrated Development in Maglev Transportation and High-speed Railway Network

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Abstract: Along with the development of the new urbanization strategy in China, it is urgent to solve problems of urban transportation, energy and environment, etc. Maglev transportation has supplemented and perfected the existing rail transit system as a new force in the rail transit industry. The medium and low speed maglev transportation has a series of advantages, including low vibration noise, strong grade ability, and small turning radius, exploration and practical experience of Changsha Maglev Express showed that it is necessary and successful to enhance the integrated development for maglev transportation and high-speed railway network. It’s strongly recommended to speed up its popularization and application.

Key words: Rail Transit, Maglev Transportation, Maglev Train Levitation Control,Industrialization Application Prospects,Integrated Development
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重庆市超长线交通研究

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摘要：随着经济发展，我国城市化进程不断加快，城市人口不断增加，而轨道交通已成为国内很多城市解决市民出行问题的必要手段，但随着城市人口急剧膨胀，轨道交通线路长度不断延伸，运营方式不断调整，会形成时间或者空间上的超长线。超长线能够保持市中心的活力，疏解大量客流，但超长线的编组方案、交路方案、停站方案难度加大，最终可能并没有减少居民的出行时间，加之客流量大，服务水平也会降低。本文就重庆市轨道交通发展状况和所存在的一些问题，采用线性模型对各条线进行评估对比，选出一条待优化的超长线，采用0—1模型对超长线做了模型分析，并根据模型优化结果提出了相应的解决办法。

关键词：重庆市；轨道交通；超长线；线性模型；0—1模型

Study on Super-long Line Traffic in Chongqing

Abstract: With the development of economy, our country city process speeds up, while rail traffic has become a necessary means to solve the problem of many city people to travel, the length of rail transit lines extends and the operators operate the mode of continuous adjustment, and there will be a long line of time or space. The super long line can keep the activity of center, ease the large amount of passenger flow, but the grouping scheme and stop scheme of super long line are more difficult, which may not reduce the travel time ultimately, and the large amount of passenger flow will also reduce the level of service. In this paper, we use linear model to assess the various subway lines to choose a long line to be optimized in the light of the development status and some problems of Chongqing rail transit. Then we apply the 0 - 1 integer model to analyze every rail transit line, and put forward the corresponding optimization method of the super long line according to the model optimization results.
Railway Freight Volume Forecast Using an Ensemble Model with Optimized Deep Belief Network

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ABSTRACT

Forecasting freight traffic contributes to arrangement of traffic facilities and making industrial policy, so it is significant to predict freight traffic accurately. Extensive works had proved that ensemble model performed better than single model, so an ensemble model, combining seasonal Autoregressive Integrated Moving Average (SARIMA) with deep belief network (DBN), is proposed in this paper. SARIMA, a linear model, is used to find the regularities of railway freight traffic. DBN, a nonlinear model, is taken to mine the complex relationships between indexes effecting railway freight and railway freight. In order to decide appropriate architecture of DBN, including the number of network layers and neurons in each hidden layer, Gaussian particle swarm optimization (GPSO) algorithm is designed to obtain suitable parameters. Besides, Spearman rank correlation analysis is used for selecting indexes related to freight traffic. Empirical results from experiments show that compared with SARIMA, DBN, BP neural network (BPNN), Elman neural network (ENN) and radical basis function neural network (RBF), the proposed ensemble model obtains best performance, and mean absolute error is 5.5159 million tons, mean absolute percentage error is 1.9657%.

KEYWORDS: freight traffic; forecast; ensemble model; deep belief network
城市轨道交通车站站台乘客聚集度分析

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摘 要：城市轨道交通站台乘客的聚集情况是反映车站站台合理性的一个重要指标，也是评价站台安全的一个因素。为了研究站台乘客聚集度，本文首先提出城市轨道交通站台乘客聚集度的概念并以站台乘客密度作为量化指标，参照行人交通流的研究方法提出站台乘客聚集度的评价指标；然后分析站台乘客聚集状态各阶段中输入输出流的变化情况；紧接着建立各个阶段的聚集度模型，基于西安地铁数个车站的实际调查数据与实时运营数据标定相关参数；之后基于模型分析站台乘客聚集度的两个影响因素——进站乘客到达站台的到达率与发车间隔；最后以西安地铁2号线市图书馆站实际调查及运营数据为例，分析其早高峰时段站台乘客聚集度的状态变化，从而验证了模型的合理性，同时分析出市图书馆站发车间隔与站台设计的合理性。

关键词：城市轨道交通；车站；站台乘客聚集度；发车间隔

中图分类号：U291.69

Study on the Passenger Gathering Degree on the Station Platform of Urban Rail Transit

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Abstract: The gathering of passengers on the urban rail transit platform is an important indicator of the rationality of the station platform and a factor in evaluating the safety of the station. In order to study the gathering degree of passengers on the platform, this paper first puts forward the concept of passenger clustering degree of urban rail transit station and takes the passenger density of the station as its quantitative index, then puts forward the evaluation index of the passenger concentration of the platform according to the research method of pedestrian traffic flow. And then the establishment of
the various stages of the input and output flow changes; followed by the establishment of the various stages of the degree of aggregation model, based on the Xi'an subway station of the actual survey data and real-time operating number of the relevant parameters of the model calibration. And then based on the model analysis studies the passenger cluster degree of the two influencing factors ------ arrival of the arrival of the station passengers arrival rate and departure interval. Finally, taking the actual investigation and operation data of the SHI TUSHUGUAN station of Xi'an Metro Line 2 as an example, analyzes the passenger arriving at the early peak hours and it’s verified that the rationality of the model, the rationality of the departure interval and the platform design.

**Key words:** Urban rail transit; Station; Platform passenger aggregation; departure interval

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中川机场高铁站客流分析及优化

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摘要：以提高中川机场高铁站各项服务设施的能力，提升其运营能力为目标，优化车站的客流流线，为车站的发展提供必要的帮助。以Anylogic仿真软件为仿真平台，建立中川机场高铁站客流仿真模型，分别对中川机场高铁站平峰时期、高峰时期的客流进行仿真模拟，并对高峰时期进行重点研究，找出其在高峰时期的不足之处。最终提出改进方案，并利用Anylogic仿真软件对优化后的车站再次仿真并与优化前进行对比，结果表明优化后进入售票大厅购票的旅客的走行距离虽然有所增加，却达到了客流分离的效果，优化后的高铁站流线清晰，交叉干扰减少，设施设备通行能力明显增加，车站疏散能力明显提高，进而提升中川机场高铁站的运营效率。

关键词：中川机场；旅客流线优化；Anylogic；动态仿真

中图分类号：U238

Analysis and Optimization of Passenger Flow at Zhongchuan Airport High-speed Railway Station

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Abstract: In order to improve the services ability and operation ability of high-speed rail station in Zhongchuan airport, optimize the station passenger flow and provide necessary help for the development of the station, the simulation model of station passenger flow for high-speed rail in Zhongchuan airport was established based on the simulation software of Anylogic, the passenger flow of mean period and peak period was simulated. This paper focused on the peak period and found out the deficiencies, put forward the improvement scheme and compared the passenger flow before and
after optimization use the Anylogic simulation software. The results show that the walking distance of passengers who entering the ticket hall buy ticket was increased but the flow separation effect was achieved after optimization, the cross line was clear after optimization, and the cross interference was reduced, the traffic capacity of facilities was increased, the evacuation capacity of the station was improved, so the efficiency of railway operation was enhanced.

**Key words:** Zhongchuan airport; passenger flow optimization; Anylogic; Dynamic simulation

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Rail Surface Defect Recognition Method Based on Multi Feature Fusion and AdaBoost Algorithm

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ABSTRACT  
For the influence of the acquisition device vibration and the interference of foreign body, in order to improve the accuracy of rail surface defect detection, the defect was recognised by extracting the defect multiple features. Firstly, according to the shape characteristics of rail, and combining Hough transform and least square method to extract rail surface area. Second, combined with excess entropy theory and fuzzy theory to divide rail surface defects. Then, by establishing the positive and negative sample databases, the sample feature database is established by extracting the Harr-like features and low-level features of the samples. Finally, the defect classifier is designed with C4.5 and AdaBoost algorithm, and the non-defect regions are excluded and the defect regions are classified. By identifying 500lx~1000lx, 1000lx~10000lx, 10000lx~100000lx in three different light intensity range of concrete sleeper and woodiness sleeper track rail surface defects, the average recognition time for 698ms, the average recognition accuracy for 97.02%, compared with the traditional recognition method has obvious advantages.

KEYWORDS: vibration; rail surface extraction; Hough transform; AdaBoost; light intensity; defect recognition.
运营期地铁结构自动化监测系统应用研究

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摘 要：针对常规的地铁隧道结构变形人工监测方法的不足，开发了地铁隧道运营期自动化监测系统，实现了对隧道变形信息掌握的实时化。本文主要介绍该系统的结构设计、系统功能、监测流程。实例证明应用自动化远程监测系统进行监测可以极大地提高工作效率和监测成果的及时性，对今后地铁隧道运营期结构变形监测具有较好的推广和应用价值。

关键词：运营期；地铁；自动化监测系统；变形监测

中图分类号: U231.94; U456.3 文献标识码: A

Study on the Development and Application of Automatic Monitoring System for Subway Tunnel

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Abstract: For the deficiency of subway tunnel structure deformation with using conventional manual monitoring methods, the automatic monitoring system of subway tunnel operation period is developed. This paper mainly introduces the structure design, system function, and monitoring process of this developed system, which achieves the real-time monitoring of tunnel deformation information. The experiments show that the automatic remote monitoring system can greatly improve the efficiency of monitoring the tunnel deformation and provide the timely monitoring results of the tunnel deformation, which will be of great application and promotion value for monitoring the tunnel deformation of the subway tunnel operation period.
Keywords: operation period; automatic monitoring system; deformation monitoring

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复杂网络理论在列控系统可靠性分析中的应用

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摘 要：列车运行控制系统对于保证行车安全至关重要，其结构复杂，子部件繁多，因此用系统性的复杂网络方法来分析可靠性十分有必要。为了分析其可靠性，本文根据复杂网络理论，将CTCS-3列控系统不同模块之间的信息交互过程抽象成网络模型，研究列控系统的网络模型拓扑结构，并计算复杂网络的相关参数体系，研究网络节点的性质以及整个网络的连通性；然后根据实际故障案例建立不同的系统失效情况下研究复杂网络相关参数的变化，从单车运行场景拓展到两车及多车，在多车运行场景下，分析同RBC管辖区域及不同RBC管辖区域内多车运行列控系统的复杂网络参数。最终得到多车同区域时复杂网络平均路径长度趋近于2，网络的拓扑效率趋近于0.5，多车跨区域情况下，当列车数与区域数均趋于无穷时，网络的平均路径长度最终趋近于3.6531，网络的拓扑效率最终趋近于0.2955。参数均趋于稳定，证明了列控系统在多车运行时的可靠性，最后分析了列控系统复杂网络的单车及多车运行场景下的节点活跃度，为可靠性分析和后续维护指导性意见。

关键词：交通工程；列控系统；可靠性分析；复杂网络；失效分析；运营场景

中图分类号：U238.2

Complex Networks Theory and Application in Reliability Analysis of Train Control System

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Abstract: Train Control System is essential for ensuring running safety, the structure of Train Control System is huge which contains many sub-components, so it is necessary to analyze the reliability of Train Control System. In order to analyze the its reliability using the systematic method such as complex networks, in this paper, based on complex network theory, the process of information exchange between different modules in CTCS-3 Train Control System is abstracted into network model to study the topology properties and understand the internal structure in-depth. The related parameters in complex network are calculated to study the connectivity properties of the network and the properties of the nodes; then according to actual failure cases, setting up different system failure models to find weak link in the train control system complex network, comparing the change of the parameters under the nodes failure and edges failure. And analyzing the reliability of the Train Control System in the scenarios expanded from single train to the two trains even multi-trains, in the scenario of multi-trains, analyzing the parameters in the same RBC jurisdiction and different RBC jurisdictions to find the trend of complex network model. Finally we can find that the average path length approach in the network topology efficiency tend to be 0.5 under the multi-trains in same RBC, the average path length approach in 3.6531, network topology efficiency tend to be 0.2955 under the multi-trains in different RBC, the parameters are stable which proved the reliability in the case of multi-trains condition. Ultimately, the activity of nodes under single train and multi train was analyzed which providing instructive advice for reliability analysis and subsequent maintenance.

key words: Traffic engineering; Train Control System; reliability analysis; complex network; failure analysis; operational scenario

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Research on the Effects of Train Operation Mode for Vehicle Energy Consumption

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ABSTRACT

The research background is based on great consumption of urban rail transit energy, through summarizing the research of scholars at home and abroad, the comprehensive research including train operation pattern, the train traction characteristics and optimization design of integrated research has carried out in this paper, by using OPENTRACK software simulation to verify the optimization results according to different line features finally. The aim of this paper is to explore ways and methods of traction strategy optimization under the condition of trains timing energy saving. The main research contents of this paper are based on the research status at home and abroad, first of all, the different operating modes of the train running on the line are analysed, including the time
saving mode, the energy saving mode and timing energy saving mode, and quantitatively analysed the influence of different operation modes on vehicle energy consumption. The influence factors and traction calculation method of energy consumption of train running are studied. Firstly, the factors that affect the energy consumption of the train are analysed, including the basic facilities and transport organization mode. On the basis of this, the train load and running status of the train are analysed, and the model of the train movement and energy consumption are calculated. The OPENTRACK software is used to establish the actual circuit model, and the simulation is verified. The results show that the reasonable operation mode of the train operation mode can greatly reduce the energy consumption.

**KEYWORDS:** Train Operation Mode, Timing Energy Saving Mode, Energy Consumption, Ant Colony Algorithm, Simulation
Train Regulation of URT Based on Max-plus Algebraic Theory

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ABSTRACT

Urban rail transit (UMT) is in strict accordance with the arranged timetable under the condition of normal operation, but in the actual operation of the process, often subject to many random disturbance, resulting in deviation from the train timetable, and even affect the normal operation of subsequent train and the system, while UMT has the characteristics of high density and intensity, on higher demands for train real-time and efficient rescheduling. Therefore, this study on the train regulation method based on max-plus algebraic theory, first analyzes the characteristics of urban rail transit operation and delay mode, then constructs the basic train operation adjustment strategy, and designed the operation adjustment algorithm based on maximum algebra. Finally, through an example of The Beijing subway line 9, the simulation analysis shows that the operation using max-plus algebraic theory can effectively solve the problem of real-time rescheduling of urban rail transit.

KEYWORDS: Urban Rail Transit; Train Regulation; Adjustment strategy; Max-plus
Integrity Enhancement of GNSS for Train Positioning

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ABSTRACT

Global Navigation Satellite Systems (GNSS) are applied to the railway field, which can provide train locations for the purpose of control in real time. This train localization function should comply with railway functional safety standards, thus, we must enhance the integrity of GNSS for train positioning. First, some principles of train localization are compared by definitions for the understanding of the proposed solutions. Second, new method for improving integrity of GNSS for train positioning is described, which compromises the D-S evidence theory and train track satellites database. Finally, the integrity of this method is experimentally examined by simulations. This method is of great value in many satellite based railway applications as train control systems.

KEYWORDS: GNSS; train; integrity; D-S evidence; train track satellites database
A Linear Programming Model for High-speed Railway Line Planning
Considering Stop-schedule and Passenger Transfer Simultaneously

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ABSTRACT

Passenger transportation among large cities mainly relies on an efficient high speed railway system, whose line configuration has direct impacts on the system operating cost, passenger travel time and passenger transfers. We considered the problem of line planning for high speed railway. To consider passenger transfer, splitting of passenger flow was allowed which was based upon direct travel and transfer passenger. This paper developed an alternative approach that took both passenger transfer and line planning into account. A mathematical programming model was developed which minimized total passenger running time subject to service constraints and capacity requirements, and transfer one time was also allowed. The model optimized on stop schedules, frequencies, train passenger flow and
so on. An algorithm was presented which solves the problem to optimality. The algorithm is based upon column generation and a branch and bound procedure. The model and algorithm were applied to a network of the high speed railway system for which it shows a substantial time reduction. Further application and extension seem promising.

**KEYWORDS:** High-speed railway (HSR); Line planning; Stop-schedules; Passenger transfer; Mixed integer programming (MIP); Branch-and-price; Splitting of passenger flow
城轨新线接入后既有站进出站量预测

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摘 要：随着城市轨道交通进入网络化运营阶段，新线接入对既有路网的影响呈现出复杂、多变的特点。为准确把握新线接入对既有路网的影响，需要对既有站进出站量进行精确预测。在既有站客流组成分析的基础上，本文提出了新线接入后既有站进出站量预测模型。首先，对北京市2012年至2015年新线接入前后进出站量变化进行可视化分析，提取关键影响因子，并采用聚类分析、多项logit模型计算各影响因子；其次，考虑自然增长构建了基于时间序列法的趋势客流预测模型，结合各类影响因素建立了基于多元回归分析的诱增客流联合预测模型。在研究车站吸引范围的基础上提出了分流客流预测模型。最后，以北京2012年至2014年历年新线接入前后数据对模型参数进行标定，预测2015年底新线接入后既有站进站量。结果显示，本模型具有较强的适用性和可操作性，预测精度良好。

关键词：城市轨道交通；数据可视化；客流组成分析；时间序列法；吸引范围

Forecast on Passenger Flow Entering and Departing of Existing Urban Railway Stations with the Connection of New Lines

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Abstract: With the network operation of urban rail transit, the impact of new lines on existing stations has presented features of complex and changeable. In order to access the impact of new lines on existing stations, it is necessary to accurately predict the passenger flow entering and departing. On the basis of passenger flow component analysis, a forecasting model on passenger flow entering and departing with the connection of new lines is proposed. First, based on data visualization and analysis of the impact of new lines over the years, key influence factors have found out and calculated by Fuzzy Cluster Analysis and Multinomial Logit Model. Second, considering natural growth of passenger flow,
a prediction model of trend passenger flow has proposed by ARIMA. Combined with all kinds of influence factors, the induced passenger flow prediction model has built based on multiple regression analysis. Based on the study of the attracting scope of urban railway stations, the forecasting model of dividing passenger flow is put forward. Finally, using the historical passenger flow data of Beijing Metro from 2012 to 2015, the proposed model was calibrated and examined. The results showed that the proposed model has better prediction accuracy and strong applicability and maneuverability.

**key words:** urban rail trasit; data visualization; passenger flow component analysis; ARIMA; attracting scope

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考虑维修计划和到发线运用的复线铁路列车运行图优化方法

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摘 要：研究了维修计划与复线铁路列车运行图一体化编制问题，考虑车站到发线数量、维修限速、取消列车等约束条件，建立了0-1整数规划模型。针对约束不同的特点，运用Benders分解算法的思想将模型分解为主问题和子问题，结合商业软件Gurobi求解模型。设计算例进行验证，比较分析了模型的不同分解算法，不同参数下列车限速和取消列车约束对模型的影响，结果表明将到发线数量约束放置在子问题中可以提高求解效率35%~55%，而列车追踪间隔约束需根据求解规模的大小而确定。

关键词：列车运行图；维修计划；整数规划；Benders分解

中图分类号：U292.41

Optimization Method for Double-track Railway Train Timetabling Considering the Maintenance Task Scheduling and the Utilization of Arrival-Departure Tracks

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Abstract: This paper investigates the joint optimization on maintenance task scheduling and double-track railway train timetabling, and the binary programming model is established considering the number of arrival-departure tracks at station, the speed limit for maintenance and the cancellation of trains. According to the function of different constraints, Benders decomposition algorithm is used to decompose the model into the master problem and the slave problem, and the master problem is solved by the commercial software Gurobi. The model and algorithm is verified by an example based on Harbin-Dalian high-speed railway train diagram, comparing and analyzing of different method to
decompose model, the influence of the train speed limit and canceling train under different parameters. The results show that the algorithm putting the constrains of number of arrival-departure tracks in the sub problem can improve the efficiency of solving by 35%–55%, however train headway constrains depend on the scale of problem.

**key words:** train diagram; maintenance task; integer programming; Benders decomposition

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城市轨道交通列车运行图协调性评估体系构建与系统研究

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摘 要：从不同尺度对城市轨道交通列车运行图进行协调性分析与评估，是实现城市轨道交通网络化运营协调与优化的重要基础。本文首先选取了大量的指标数据进行归纳总结，提取了运营协调决策中的共性需求，构建了适应运营管理的城市轨道交通列车运行图协调性评估指标新体系。其次基于该指标体系，本文开发了完整的城市轨道交通列车运行图协调性评估系统，可以对点（车站）、线（运行线）与面（运行图）进行全方位综合评估。最后，以北京市实际路网运营情况为例，在10秒内完成各项指标计算，计算结果得到了北京市交通信息中心与北京地铁运营有限公司的专家认可，可以为列车运行图进一步优化编制提供有效地支撑。

关键词：城市轨道交通；列车运行图；协调性；指标体系；评估系统

中图分类号：U238

Research on Compatibility Evaluation Index Framework and System of Train Diagram in Urban Rail Transit

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Abstract: It is important to analyze and evaluate the compatibility of train diagram from different scales in order to realize the coordination and optimization of urban rail transit network operation. Firstly, this paper constructs a new compatibility evaluation index framework of train diagram in urban rail transit adapted to operation and management by selecting index from a lot of data and extracting common demand from coordination decision-making. Then develops a complete computer system for evaluating spot(station), line(running line) and plane(train diagram) in all directions based on the index framework. Finally, results are accomplished within 10 seconds by taking the case of actual network
operation in Beijing. The results are recognized by the experts from Beijing Traffic Information Center and Beijing Subway, also provides effective support for the further optimization of train diagram.

**key words:** Urban Rail Transit; Train Diagram; Compatibility; Index Framework; System

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基于乘客刷卡数据的列车拥挤度指数计算方法研究

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摘 要：随着城市轨道交通运营里程的不断增加，路网客流量急剧上升。为了提高路网运营管理水平，保障行车安全，列车拥挤度指数的研究具有重大意义。本文首先给出了列车拥挤度指数的定义，并构建了拥挤度的模型；其次利用时空k短路算法得出不同城市轨道线路的实时列车拥挤度；最后基于西安地铁的乘客刷卡数据，耗时3分钟计算得到了列车拥挤度，并与人工实际路网调查数据进行对比。结果表明：列车拥挤度模型与时空k短路算法具有可行性和正确性，能为今后路网内部运营管控，车站外部限流提供建设性意见。

关键词：乘客刷卡数据；列车拥挤度指数；时空k短路算法；城市轨道交通

中图分类号：U238

Research on the Calculation Method of Train Congestion Index Based on the Data of Passenger’s Credit Card

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Abstract: With the increasing of the operating mileage of the subway, the traffic volume of the road network has risen sharply. In order to improve the level of operation management and ensure the safety of the traffic, the research on the train congestion index is imminent. In this paper, firstly, the definition of congestion index is put forward, and the congestion degree model is constructed. Then, the real-time congestion degree of different train lines is obtained by using the algorithm based on the spatial and temporal K short circuit. Finally, the paper analysis and calculate the train congestion about 3 minutes based on the Xi'an subway passengers card data. Compared to the actual results, we come to the conclusion that train congestion model and time space K short circuit algorithm are feasible and
correct. This paper will provide constructive suggestions for the outer limit of the station control and management of the road network.

**key words:** Passenger card data; Train congestion index; K short path algorithm; Urban Rail Transit

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基于微进化算法的列车运行调整优化研究

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摘   要：列车运行调整对确保列车按图行车，降低突发事件对铁路运输组织影响，提高运输效率和铁路安全具有重要意义。在铁路货运体制改革背景下，列车运行调整应充分考虑铁路货运时效性，本文以提高货主对货运时效性的满意度为目标建立列车运行调整优化模型，并设计基于基因结构进化机制的微进化算法对模型进行求解，微进化算法能够在种群进化过程中保留染色体中的优秀基因结构，并结合改进的原始对偶算子更好地适应动态环境。经算例验证，微进化算法在算法质量及效率方面较传统遗传算法有明显优势。

关键词：列车运行调整；微进化算法；基因结构；货运时效性

Study on Optimization Model of Train Operation Adjustment Based on Micro-evolution Algorithms

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Abstract: The train operation adjustment is of great significance to ensuring reliability and safety running of trains when train operation is disturbed by emergencies, and is critical to improve transport efficiency. Under the background of railway freight system reform, the freight transport timeliness should be fully considered when adjusting the train diagram. In this paper, a train operation adjustment model has been built, where the satisfaction of shipper has been treated as objective function. Micro-evolution algorithm (MEA) has been used to solve this problem which is designed based on gene structure evolution. MEA preserved dominant gene structures during the procedure of evolution and is more suitable to dynamic environment based on revised primal-dual mapping operator. Sample tests
show that the MEA performs better than conventional GA both in quality and efficiency in dynamic environment.

**Key words:** Train operation adjustment; Micro-evolution Algorithms; gene structure; Freight transport timeliness

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角志达（1991-），北京交通大学交通运输学院，联系电话：15201315159，邮箱：14120948@bjtu.edu.cn
城市轨道交通跨线运行组织模式探讨

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摘 要：从共线形式和过轨方式两个方面对城市轨道交通跨线运行组织模式进行探讨，对不同组织模式下跨线列车的行车密度进行分析。结果表明："插入式"共线形式下跨线列车可开行的最大行车密度与其过轨方式有关，"取代式"共线形式下跨线列车可开行的最大行车密度主要受被跨线路未共线区段客流需求的限制。针对不同的共线形式和过轨方式，分析其特点和适用性，为跨线运行组织模式的选取提供指导意见。

关键词：城市轨道交通；跨线运行；运行模式；行车密度

中图分类号：U292.

Discussion on Joint Operation Modes of Urban Rail Transit

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Abstract: The organization modes of urban rail transit were discussed from two aspects of the shared-path operation and rail crossing modes. The density of cross-line trains under different modes were also analyzed. The results show that the maximum density of cross-line trains under the shared-path operation of "insert" is related to the rail crossing modes, and that under the shared-path operation of "replace" is mainly limited by the passenger demand on the non-collinear section which is in the shared-path line. According to different modes, the characteristics and applicability were analyzed, which can provide guidance for the selection of joint operation modes.

key words: urban rail transit; cross-line operation; operation modes; density of trains
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A Mixed Integer Programming Model for High-speed Railway Line Planning Based on Time-Dependent Demand

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ABSTRACT

This paper discusses the problem of line planning (LPP) for High-speed railway (HSR) based on time-dependent demand. Although LPP has been widely studied, few studies deal with the problem of line planning with time included (LPPT). This paper presents a mixed integer programming for optimization of line planning which optimizes on frequency for each time interval, stop-schedules and passenger train assignment. Although we concentrate on LPP, also operating time usually included in timetable are considered based on time division into fixed time intervals (e.g. an hourly basis). An algorithm was presented which solves the problem to optimality. The algorithm is based upon column generation and a branch and bound procedure. An empirical study on a simplified HSR network in
China is conducted to demonstrate the effectiveness of the model and the proposed algorithm. The case study shows that the model presented in this paper can be applied in practice and reduce the complexity of train schedules. Further application and extension seem promising.

**KEYWORDS:** High-speed railway (HSR); Line planning; Time-dependent demand; Stop-schedules; Mixed integer programming (MIP); Branch-and-price; Time divide
基于探地雷达属性路基含水状态识别方法研究

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摘 要: 铁路路基含水状态是路基质量的重要指标, 也是路基检测的重点和难点。传统检测方法不能满足快速发展的需要。探地雷达具有检测快速、高效、无损等特点, 但无法直接识别基床含水状态。本文通过模型试验, 利用探地雷达数据属性分析和神经网络相结合的方法对铁路基床含水状态进行自动识别, 取得较好的效果。具体步骤是从雷达信号中提取总振幅、平均能量、总能量等15个时域属性以及宽频带总能量、主频带能量和百万频带能量百分比等6个频域属性参数, 把这21个属性参数作为BP神经网络结构的输入, 含水状态作为神经网络结构的输出, 通过对神经网络的训练和测试, 基床含水状态识别的正确率均在90%以上, 能够满足路基含水状态评价要求, 为铁路路基含水状态检测提供了新方法。

关键词: 含水状态; 探地雷达; 属性分析; BP神经网络; 模式识别

Study on Identification Method of Subgrade Water State Based on Ground Penetrating Radar

Abstract: Railway subgrade moisture condition is important indicator of railway quality, and it is also the emphasis and difficulty of subgrade detection. Traditional detection methods cannot meet the requirements of railway high speed development. Ground penetrating radar(GPR) is an effective, speedy and non-destructive technology. However, subgrade moisture condition cannot be directly recognized by GPR. In this paper, the automatic recognition of subgrade moisture condition is realized through combination of GPR attribute analysis and neural network pattern recognition. 15 attributes in time domain and 6 attributes in frequency are extracted from GPR signals, which is total amplitude, average energy, total energy, main frequency band energy, percentage of 100 MHz bandwidth energy and so on, at the same time, The above 21 GPR attributes are inputted to BP neural network for both training and testing. Subgrade moisture condition is indicated by the outputs of the
network. Experiments results showed that the recognition accuracy is over 90 percent, which can meet requirements of railway subgrade moisture condition assessment. Hence, a new method is provided for detection railway subgrade moisture condition.

**Keyword**: moisture of subgrade; Ground Penetrating Radar (GPR); Attribute Analysis; BP Artificial Neural Network (BP ANNs); Pattern Recognition

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摘 要：现代有轨电车作为新兴的城市轨道交通，与地铁、轻轨、高速铁路的设计有着众多方面的显著差别，本文在现有路基设计理论的基础上结合南京河西地区有轨电车的工程实践情况，研究阐明了本项目沉降控制标准的确定依据、地基处理方案的主要影响因素、路基结构的设计参数，为制定有轨电车合理的设计标准提供参考。

关键词：有轨电车，整体道床，沉降标准，地基处理

The Tramcar Roadbed Design Features in Nanjing Hexi

Wei He

Abstract: Modern trams as emerging urban rail transit, have significant difference with subway, light rail, or high-speed railway. In this paper, on the basis of subgrade design theory, and combined with the engineering practice of Nanjing Hexi area trams, studies and summarizes the design key points of a streetcar, research of the settlement control criterion, the main influence factors for foundation treatment, the design parameters of subgrade structure, to provide reference for tram reasonable design standards.

Keywords: The tram, integrated bed, settlement, foundation treatment

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Based on Urban Spatial Form and Traffic Corridor to Research on the Layout Method of Line Network of Urban Railway

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ABSTRACT

The urban spatial form is a comprehensive result of interaction between various human activities and natural factors in a certain geographical environment and a certain social development stage. The urban transport corridor is the urban traffic "aorta", what makes scattered and sporadic urban traffic flow relatively concentrated in the corridor. Based on the qualitative analysis of the interactive relationship between urban spatial shape and traffic corridors, this paper determines the importance of urban railway network layout by means of traffic location theory and principal component analysis, and analyzes the importance of distribution nodes of the passenger flow to carry out screening to form a layout scheme of line network of urban railway.

KEYWORDS: urban Spatial Form; Traffic Corridor; urban Railway; Line Layout
Research on Urban Railway Transit Driver's Mental Workload Based on Improved Extension Model

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ABSTRACT
The evaluation model produced by the research on urban railway transit driver's mental workload based on original science and Extenics. This paper uses the SHEL model to establish an index system including 13 important indexes that reflect the influence on individual mental workload
of drivers. The SHEL model and the index system are also used to design the driver pressure source questionnaires. 300 qualified drivers were randomly selected from Shanghai Urban Rail Transit Company and participate in questionnaire survey and psychological interview. According to the Extension method, we determine the weights of 13 indexes in the questionnaire data, then structure the classical domains and the joint domains of mental workload, and calculate the correlation value, then build the correlation function and the extension evaluation model. The improved evaluation model based on the grey relational analysis (GRA) method is more comprehensive and accurate. Finally, through a concrete sample of the application, we managed to investigate the feasibility and reliability of the improved extension evaluation model. The research results can provide decision-making reference for drivers’ performance management and are also good for enhancing and ensuring urban rail traffic safety and efficient operation.

**KEYWORDS:** Safety operation, Urban railway transit driver, Mental workload, SHEL model, Improved extension model
一种基于5M的轨道交通信号系统安全预评估方法

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摘   要：城市轨道交通安全预评估是在项目实施前开展的风险预测、分析和控制活动，由于城市轨道交通信号系统是安全相关系统，目前国内对其开展的预评估理论研究和实践较少。本文以形成轨道交通信号系统安全预评估方法为研究目标，首先从系统全生命周期的角度阐述了信号系统预评估过程，其次提出了基于Mission(任务)、Man(人)、Machine(机器)、Management(管理)、Media(环境)的5M多因素的信号系统预评价模型，由此形成信号系统安全预评估方法。最后，通过案例分析和应用，证实了该预评估方法的正确性，能够从系统全生命周期各阶段全面地实现对信号系统安全预评估，为工程可行性提供依据，也为安全相关系统的安全预估做出了有益探索。

关键词：轨道交通；信号系统；安全预评估；全生命周期；5M

5M Based Safety Pre-evaluation Method of Urban Rail Transit Signalling System

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Abstract: Urban rail transit safety pre-evaluation is a risk prediction, analysis and control activity carried out before the implementation of the project. As the urban rail transit signalling system is a
safety-related system, its pre-evaluation theory and practice are less in China. This paper focuses on the formation of signalling system pre-evaluation method. Firstly, the pre-evaluation process of signalling system is expounded from the perspective of the system life cycle. Secondly, a multi-factor pre-evaluation model based on Mission, Man, Machine, Management, and Media (5M) is presented. Combined the process with the model, a pre-evaluation method of signalling system is formed. Finally, through the case application, the pre-evaluation method is proved to be correct, and can accomplish the signalling system safety pre-evaluation from the system life cycle. This method provides the basis for engineering feasibility, and makes a useful exploration for the safety related system pre-evaluation.

Key words: urban rail transit; signalling system; safety pre-evaluation; life circle; 5M

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电话闭塞方法在上海地铁运营应用中的优化

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摘 要: 电话闭塞法是城市轨道交通信号系统无法正常工作时采用的降级的人工闭塞方法, 当信号设备发生故障时, 确保地铁安全、有序的运行。分析数次电话闭塞法演练评估结果, 并结合城市交通自身特点找出电话闭塞法作业的不足, 进行改进及优化。

关键字: 城市轨道交通, 行车组织方法, 电话闭塞法

Optimization of Telephone Occlusion Method in Shanghai Subway Operation

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Abstract: It is Telephone occlusion method that is a degradeartificial occlusion method. To ensure that the subway safe and orderly operation, when the urban rail transit signal equipment failure. Through the results of several telephone occlusion exercises, finding out the shortcomings of telephone occlusion method and optimizing it.

Key words: urban rail transit; operation system; telephone occlusion method

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空轨交通在中国大中城市的发展前景研究

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摘 要：根据对中国大中城市交通拥堵的深层次原因分析，并对各种公共交通系统及模式的优劣势对比，从而提出以发展城市轨道交通，特别是通过构建符合中国国情和大中城市发展特点和管理需求相匹配的空轨交通系统来有效解决城市交通拥堵问题，从而进一步优化城市结构和布局，提升中国城市发展水平和居民生活品质，同时也对未来发展中国空轨交通行业提出设想与展望。

关键词：轨道交通；行业发展；分析

Study on the Prospect of the Development of Sky Railway in the Large and Medium-sized Cities in China

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Abstract: Based on the analysis of the deep-seated reason that caused traffic congestion in the large and medium-sized cities in China and the comparison between the strengths and weaknesses of all kinds of traffic system and mode, this paper puts forward the improvement of urban rail transit, especially, the Sky Railway system that conforms to the situation in China and the characteristics and requirements of the large and medium-sized cities so as to optimize the city structure and layout, improve the development of cities and the quality of urban residents and the standard of city life. Meanwhile, some proposals and future researches have been given as well in the article.

key words: orbital transportation; the prospect of the industry; analysis

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基于计算机视觉的钢轨扣件检测算法研究

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摘 要：钢轨扣件是轨道上用于联结钢轨和轨枕以保持轨距和阻止钢轨相对于轨枕纵横向移动的重要部件，一旦发生缺失将会给列车的正常运行带来安全隐患，因此需要及时对扣件缺失情况进行检测。针对当前扣件检测法不能快速有效地对缺失情况进行检测的需要，提出了一种基于计算机视觉的钢轨扣件缺失检测算法。使用改进的中值滤波算法滤除采集到钢轨扣件图像存在的噪声，通过对图像进行小波分解得到图像的低频部分以减少算法的运算量，利用主成分分析法提取扣件图像的特征向量，最后利用最小距离分类器对扣件情况进行检测。实验结果表明：该算法能够有效检出轨道扣件缺失，检测速度快，鲁棒性好。在扣件未被遮挡情况下检出率为94.64%。当扣件存在遮挡情况，检出率为89.29%。

关键词：钢轨扣件；中值滤波；小波分解；缺失检测；主成分分析法

中图分类号: TP 391.4

Research on Detection Algorithm of Rail Fastener Based on Computer Vision

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Abstract: The track rail fastener is a part to connect the rail and sleeper to keep Keep rail spacing and prevent rail relative to the sleeper aspect to the important parts of mobile, once track rail fastener is lost will bring hidden trouble to the normal operation of the train. Therefore, it's need for timely detection of missing fasteners. In order to solve the problem that the current detection method can not detect the
missing of track rail fastener quickly and effectively, this paper puts forward a new method based on computer vision to detect the missing rail fastener. Using the improved median filtering algorithm to filter the noise existing in the rail fastening image, having wavelet decomposition on the image to get the low-frequency part of the image in order to reduce the computational complexity of the algorithm, using the principal component analysis method to extract feature of fastener image, finally the minimum distance classifier is used to detect the situation of fastener. The experimental results show that the proposed algorithm can effectively detect the missing rail fastener, the detection speed is fast, and the robustness is good. The detection rate was 94.64% when the fastener was not blocked. When the fastener is blocked, the detection rate is 89.29%.

Key words: rail fastener; median filtering; Wavelet decomposition; deletion detection; Principal component analysis

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无砟轨道沥青垫层粘弹性特性对轨道结构动力响应的影响

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摘   要: 本文运用ABAQUS建立无砟轨道三维有限元模型，分别采用浇注式GA、SMA10和环氧EA三种沥青混合料作为全断面轨下基础的垫层，研究三种垫层在不同温度下的粘弹性特性对轨道结构应力、变形和加速度的影响，并结合试验段监测结果进行分析。研究发现: 不同温度下三种垫层材料的松弛时间变化较大; 温度条件和垫层材料类型对结构的应力的分布情况有较大的影响，而对位移幅值和加速度幅值的影响相对较小; 高温对结构的应力衰减有利，而对位移和加速度的衰减不利; 综合考虑动力响应的分析结果，发现沥青垫层的松弛时间\(\tau_i\)越小，对轨道结构的减振效果越好。

关键词: 无砟轨道; 沥青混凝土垫层; 粘弹性参数; 动力响应

Influence of Asphalt Cushion Viscoelasticity on Structural Dynamic Response of Ballastless Track

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Abstract: This article establishes three-dimensional finite element models of ballastless track using ABAQUS software which apply three kinds of asphalt mixture including casting GA, SMA10 and epoxy EA to cushion under rail to study the influence of viscoelastic properties of three cushions on the stress, deformation and acceleration under different temperatures, and the test section monitoring results are analyzed too. The results show that the relaxation time of the three materials change greatly at different temperatures. The influence of temperature and materials on the stress distribution of the structure is great while the influence on the displacement amplitude and the acceleration amplitude is relatively small. The high temperature is beneficial to the stress attenuation but not favorable to the
attenuation of the displacement and acceleration. Considering the results of dynamic response analysis, it is found that the smaller the relaxation time is, the better the damping effect of the asphalt concrete cushion on the track structure will be.

**Key words:** ballastless track; asphalt concrete cushion; viscoelastic parameters; dynamic response

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Research on Methods of Segmentation for Rail Surface Defects in Image-based Rail Inspection System

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ABSTRACT

In image-based rail inspection system, the effect of segmentation for rail surface defects is easily affected by the change of illumination and properties of surface reflection. This paper proposes a segmentation algorithm for rail surface defect image based on the background subtraction method. Firstly, through the design of detection device, the rail image is acquired and its characteristics are analyzed. Secondly, in order to improve the accuracy, correlation coefficient and Euclidean distance is combined to measure similarity between the pixel neighborhoods. Then, by using similarity measurement results to determine the scale of neighborhood averaging, the multi-scale background image model is established. Finally, the segmentation of rail surface defects is realized by image differencing and setting threshold for the differential image. This method makes full use of the similarity information between the pixel neighborhoods in the rail image and an accurate model of the background image is established according to different area-based feature in the image. Therefore, it can effectively reduce the impact of the uneven illumination and the reflection characteristics of rail surface, and meanwhile highlight...
the defect area in the image. The experimental results show that this method has a good effect on segmentation of both block and linear defects which distributed discretely in the image.

KEYWORDS: Rail Surface Defect, Similarity, Neighborhood averaging, Image Segmentation.
Electrical Resistance and Strength Property of Cement and Asphalt Mortar

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ABSTRACT
Aiming at hardening system of cement asphalt mortar (CAM), four-pole method was adopted to monitor its electrical resistance alteration in 28 days. The microstructure and the compressive strength of CAM were also analyzed. The result indicates that electrical resistance alteration of four types of CAM meet the logarithmic growth trend. The fundamental cause to electrical resistance value of four types of CAM at the same time is microstructure changes of CAM with different A/C. And the growth of electrical resistance has a good linear relation with that of compressive strength.

KEYWORDS: cement asphalt mortar, electrical resistance, hardening system, strength, microstructure
中国高速铁路发展对国内现代化社会重构及其成为全球化中心建设的影响探讨

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摘要：中国自2008年开通首条高速铁路以来，截至到2016年底，其运营里程已突破2万公里。伴随着中国高速铁路的迅猛发展，对其社会现代化进程及全球化发展的影响越来越显著。本文将高速铁路作为技术、社会、政治、经济等要素构成的异质综合体，探讨了高速铁路建设与社会发展的互动关系；分析了中国高速铁路技术本土化过程为中国新型现代化社会重构提供了新途径，提出了高速铁路建设将使中国成为新型全球化中心的理念。

关键词：中国高速铁路；现代化社会重构；全球化中心建设；社会发展


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Abstract: Since China opened its first high-speed railway in 2008, as of the end of 2016, its operating mileage has exceeded 20,000 km. With the rapid development of China's high-speed railway, its influence on the process of China’s modernization and globalization becomes more and more significant. This paper will regard the high-speed railway as a hybrid which combines technical, social, political, economic and many other elements and explore the interactive relationship between the construction of the high-speed railway and social development. Moreover, this paper will analyze the localization process of China's high-speed railway technology which opens up a new route to China's modernization. Furthermore, the construction of high-speed railway will make China become a new
center of globalization.

**Key words:** high-speed railway; reconstruction of China's modernization; construction of globalization center; social development
Experimental Test of Bogie’s Secondary Suspension Stiffness Based on the Bogie Test Bench

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ABSTRACT
For the realization of static and dynamic stiffness of bogie’s secondary suspension test, a separated test method of three dimensional dynamic and static stiffness of bogie’s secondary suspension was proposed, and the dynamic and static stiffness of the secondary suspension of a certain model of metro trailer bogie was measurement, thus the characteristic curve of the secondary suspension system was obtained. The error between the test values and the design values of the longitudinal static stiffness test of 1# secondary air spring was up to 18.1%, exceeding the 10% tolerance required by the design department, and the dynamic stiffness of 1# air spring had a rapid increase in wave crest at about 5Hz. Based on the above test results, presumably the anomalies of 1# secondary air spring stiffness is due to the #1 air spring’s quality or size does not meet the requirements, 1# secondary air spring assembly relations should be adjusted, which indicated the necessity of suspension parameter checking after assembling the bogie.

KEYWORDS: Bogie test bench; Bogie; Stiffness test; secondary suspension; Air spring
重大线性工程滑坡风险分析与选线研究
——以川藏铁路康定至林芝段为例

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摘 要：在铁路工程设计中选择合适的评价方法对线路设计方案进行比选分析，从而选出最优的选线规划方案是前期研究的主要工作。本研究根据拟建川藏铁路康定至林芝段沿线滑坡灾害的孕灾环境、诱发条件和灾害特征选取了断层距离、地层岩性、相对高差等10个风险评价指标，采用贡献权重法(CRW)对四种设计方案线路进行了定量风险评价。在此基础上对川藏铁路4种选线方案线路进行滑坡风险分析和线路方案比选，最后结合川藏铁路穿越经济据点和建设长度指标，综合推选出现塘—八宿方案为最优方案。本研究所述的方案比选思路对类似重大线性工程项目的线路方案比选具有一定的参考价值。

关键词：线性工程；滑坡灾害；风险分析；贡献权重法；川藏铁路

中图分类号：P642.2，U212.32 文献标识码：A

Risk Analysis and Line Selection Research of Significant Linear Projects: A Case of Kangding- Nyingchi Section on Sichuan-Tibet Railway

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Abstract: In order to select the optimal planning scheme in previous studies, appropriate evaluation method is applied to comparison and selection analysis of route design plans in railways engineering design. Ten hazard evaluation indexes as fault distance, formation, relative difference, and so on,
are selected based on hazard inducing environment, trigger conditions and disaster characteristics of landslide disaster along proposed Kangding- Nyingchi section on Sichuan – Tibet railway in this study. The evaluation method of contribution weight approach is applied to the hazard quantitative evaluation of four kinds of design scheme of circuit. Hazard grading and mapping are done in GIS system by natural breaks method. Litang - BaSu scheme was selected as the optimal solution based on the hazard, length and the economic strongholds of four kinds of line selection scheme. The idea on the comparison and selection of line plans in this study have reference significance to the comparison and selection of similar significant linear projects.

**Key words:** linear project; landslide disaster; risk analysis; contribution weight approach; Sichuan-Tibet railway

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Fuzzy Comprehensive Evaluation on Passenger Flow Channel Organization Service Level and Instance Analysis

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ABSTRACT
In order to improve the quality of passengers’ traffic and transfer, and the efficiency of transport terminal channel organization, through questionnaire survey, find out key issues to evaluate. On basis of establishing evaluation index system on passenger flow channel organization service level, use
AHP theory and describe its steps in detail, on the base of which to get each index weight. Then make assessments in fuzzy comprehensive evaluation. Finally, make instance analysis on certain transport terminal of Xuzhou, which indicates the significance of the method to apply fuzzy comprehensive evaluation into the evaluation on passenger flow channel organization service level. As to certain urban transport terminal, this method is very useful to change the bad aspects and improve service quality.

**KEYWORDS:** traffic engineering; level of service; fuzzy comprehensive evaluation; passenger flow channel organization; evaluation index system; questionnaire survey
Numerical Simulation of the Long-term Bearing Behavior of Pile-Supported Reinforced Soft Embankment for High-speed Railway

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Abstract: The high-speed railway needs a strict deformation requirement for subgrade; the long-term behavior of embankment needs to be extensively studied. A 3D finite element model was established based on the typical subgrade structure high-speed railway. The evolution mechanism of bearing capacity of pile-supported reinforced subgrade under long-term loading was studied by the viewpoint of modulus attenuation of soil. The distribution of soil modulus attenuation, the axial force distribution of pile body, the pile-soil stress ratio and the deformation and settlement of roadbed were obtained.
under different cycle times. The results showed that with the increase of the number of decay cycles, the axial force and the pile-soil stress ratio of the pile increase. After 100000 cycles, the axial force of the pile body becomes stable, but the pile-soil stress ratio still tends to increase. The pile-soil stress ratio changes mainly in the upper part of the pile. Although the attenuation of the soil modulus increases with loading cycle, the variation of deformation and settlement of subgrade is small, so the reducing effect of pile-support reinforced subgrade in settlement is effective.

**Key words:** high-speed railway; pile-support reinforced subgrade; soft clay; numerical simulation; modulus attenuation

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Investigation of Geogrid-Reinforced Railway Ballast Behaviour Using Large-scale Triaxial Testing

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ABSTRACT

Geogrids have been used to effectively improve the performance of unbound aggregate layers in transportation applications by providing confinement and preventing movement through interlock between particles and their apertures. This paper presents an experimental study that a large-scale triaxial facility has been used to simulate in-situ condition and loading conditions of railway ballast to investigate the effects of geogrid reinforcement. A series of unreinforced ballast samples without geogrid have first been tested. A series of ballast samples reinforced with various size and number/position of geogrids have also been tested. This paper also investigates the resilient behaviour of ballast particle, such as the resilient modulus and Poisson’s ratio of each sample. The influence of
initial sample density on permanent settlement has been investigated. According to the test results, the effect of the aperture size of geogrid and number/position of geogrids within the sample has also been investigated. The study concluded that geogrid reinforcement of granular material subjected to repeated loading provides a reduced rate of permanent deformation.

**KEYWORDS:** Railway ballast, triaxial test, geogrid reinforcement, resilient behaviour, permanent settlement
成绵乐城际铁路开通对乐山市旅游业的影响分析

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摘要：近年来，城际铁路的建设方兴未艾，其起到了便捷出行、串联城市、促进区域一体等作用备受政府和旅客喜爱。本文运用文献研究法，比较分析法以成绵乐城际铁路对乐山市的旅游影响为例，结合城际铁路的技术经济特点，分析来乐旅客交通方式的变化趋势及城际铁路开通后对乐山市旅游的影响。分析发现城际铁路的开通运营使乐山市旅游人数和综合收入都实现大幅度增长，对传统的公路方式产生冲击，在节假日、一日游，重点景区等不同的旅游时间与方式产生影响，最后针对旅游交通的发展提出了一些政策建议，可以为同类旅游城市的交通规划和组织提供决策支持。

关键词：成绵乐城际铁路 旅游业

An Analysis of the Impact of Chengmianle Intercity Railway on Tourism Industry in Leshan

Abstract: In recent years, the construction of inter-city railways is in the ascendant. Such kind of railway is popular among governments and passengers because it makes travelling convenient, connects cities, and promotes regional integration. In this paper, literature research method and comparative analysis method are used, and the influence of Chengdu-Mianyang Leshan intercity railway on the tourism of Leshan is taken as an example. The technical and economic characteristics of inter-city railways are relied upon to analyze the change of Leshan passengers’ means of transportation, and the influence on Leshan tourism after the intercity railway is put into operation. Based on the analysis, it is believed that the operation of inter-city railway will result in substantial increase in tourist number and consolidated income of Leshan. It will also impact the traditional approaches of road transportation,
and also influence the time of travelling, for example, holidays and festivals, and the mode of tourism such as one-day tour and key scenic area visit. Finally, some policy suggestion is put forward for the development of tourism transportation, and this can provide decision support to similar tourism cities regarding their transportation planning and organizing.

**Keywords:** Cheng Mian Leintercity high-speed railway

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适用于寒区高铁路基的耐久性沥青混凝土防水封闭层

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摘 要：寻求更为稳定耐久的防水封闭方案对于寒区新建高铁路基冻胀融沉变形的控制至关重要。本文系统分析了国内外交通基础中的防水方案，总结了沥青混凝土的特点，提出了寒区高速铁路沥青混凝土防水封闭层的功能原则与技术标准，结合哈齐客运专线试验段的实施与跟踪监测结果验证了自密实沥青混凝土及相关技术标准在寒区高铁路基防水封闭层中的适用性。

关键词：高速铁路; 路基防水封闭层; 自密实沥青混凝土; 寒区

A Durable Bituminous Waterproofing System for the Subgrade of High Speed Railway in Cold and Frost Area

Abstract: A durable and long-lasting waterproofing system is critical to the subgrade of highspeed railway as it can prevent the runoff penetration and maintain the bearing capacity of the subgrade, especially for the railway structure in cold and frost area. The paper summarized the performances of various waterproofing approaches adopted in the transportation infrastructure, analyzed the technical characteristics of two type of asphalt concrete. Based on the experience of asphalt concrete waterproofing test track on Harbin-Qiqihar highspeed railway, the principle for the waterproofing system for the subgrade in cold and frost area were proposed with the specifications for designing asphalt concrete, which can be a well demonstration of the feasibilities of application the self-compacted asphalt concrete as a waterproofing material in these area.

Keyword: Highspeed railway; waterproofing system of the subgrade, self-compacted asphalt concrete; cold and frost area

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A Method to Monitor Railway Tracks’ Foreign Body Invasion Based on Φ-TDOR

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ABSTRACT

A new method based on phase sensitive optical fiber sensing technology (Φ-TDOR) is presented in this paper. The method first uses Φ-TDOR to acquire the original signal of railway tracks’ vibration for a while, then conducts filtering, short-time Fourier transform and auto regressive model spectrum
estimation of the original signal; After analyzing the frequency signal feature, we can determine whether any events have happened on the track; Finally, invasion events can be distinguished by comparing the signals between the position and the adjacent ones. This method only uses the existing rail cable, without additional workload of construction, and can achieve a wide range of distributed detection, which has important potential application value for the railway operation safety and disaster prevention.

**KEYWORDS:** Φ-TDOR; railway tracks; foreign body invasion; frequency feature
西安地铁十二号线开通对十四号线客流预测的敏感性分析

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摘 要：城市轨道交通客流预测是轨道交通项目建设的重要环节，在项目可行性研究阶段，是项目建设必要性和可行性的主要依据。任何发展预测都是在一定的前提下作出的，预测的基础条件发生改变，预测结果也会相应有一定的变化，客流预测也是如此。地铁新线的开通会对城市既有线网的客流造成一定的影响，线路路由选择是影响客流大小的关键敏感性因素，关系到客流预测的准确性。本文就十二号线开通对十四号线客流预测结果做了敏感性分析，首先分析了十二、十四号线的网络结构，然后选择乘车时间、换乘时间、换乘次数三个因素建立效用函数，计算效用值，依据一种基于改进Logit模型的流量分配算法，得到十二号线开通后，十二、十四号线的机场客流配流结果以及十四号线机场客流向十二号线的转移比率。研究结果表明，若十二号线按时开通运营，将发挥更大的网络效应，十四号线客流的27.2%转移至十二号线。

关键词：客流预测；敏感性分析；网络结构；流量分配

中图分类号：U49

Passenger Flow of Line14 Sensitivity Analysis Based on the Line 12 Opened Operations

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Abstract: Urban rail transit passenger flow forecast is an important link in the construction of rail transit project. It is the main basis for the necessity and feasibility of the project construction in the project feasibility study stage. Any development forecast is made under certain conditions, the basic conditions of the forecast change, the forecast results will be a corresponding change, so is passenger flow forecast. The opening of the new subway will cause some influence on the passenger flow of the existing network. The route selection is the key sensitive factor which affects the passenger flow size, which is related to the accuracy of the passenger flow forecast. This paper analyzes the sensitivity of
the Xi'an Metro Line 12 to the passenger flow forecast on the line 14, first analyzed the 12, 14 line network structure, and then select the travel time, transfer time, transfer times three factors to build an improved Logit model of traffic allocation algorithm. Finally, we came to the 12th and 14th line of the airport passenger flow distribution results and the transfer rate from the 14th line airport passenger flow to the line 12 after the opening of the line 12. The results show that if the line 12 opened operations, it will produce a greater network effect, so make that the 27.2% airport passenger flow on the 14th line transfer to the 12th line.

**key words:** passenger flow forecasting; sensitivity analysis; network structure; traffic allocation
路基基础上高速铁路CRTS-III型板式无砟轨道结构在温度-列车荷载共同作用下的力学特性

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摘 要：CRTS-III型板式无砟轨道作为我国具有完全自主知识产权的轨道结构，目前尚未确定标准的轨道结构形式。在此大背景下，本文采用ABAQUS有限元软件建立了路基上CRTS-III型板式无砟轨道结构有限元模型，分析了轨道板是否纵连对温度-列车荷载共同作用下CRTS-III型板式无砟轨道结构静力特性的影响。结果表明：轨道板间纵连对板边的翘曲变形具有一定的约束作用，有利于减小填充层顶面最大竖向应力（包括拉应力和压应力）和底座板底最大纵向拉应力，但会增大轨道板板底（板顶）最大水平拉应力。在此基础上进一步分析了填充层弹性模量对温度-列车荷载共同作用下轨道结构静力特性的影响。

关键词：CRTS-III；板式无砟轨道；温度-列车荷载共同作用；静力特性

Static Behavior of CRTS-III Slab Ballastless Track under Combined Temperature and Train Loading

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Abstract: At present as a railway structure with completely independent intellectual property rights CRTS-III slab ballastless track still has no unified structure. In this study, two types of CRTS-III slab ballastless tracks on subgrade are established by virtue of ABAQUS Finite Element Program, including longitudinal connected ballastless track and element slab ballastless track. The static behaviors of the
two types of slab ballastless tracks under combined temperature and train loading are compared. The results indicate that the longitudinal connecters between slab tracks constraint the warping deformation of slab borders and are helpful to reduce the vertical stress (both tensile stress and compressive stress) on the top surface of filling layer and the maximum horizontal tensile stress on the bottom of the base. However, they will increase the maximum horizontal tensile stress on the bottom (or top surface) of the slab. On this basis, the influence of elastic modulus of filling layer on the static behaviors of the two types of slab ballastless tracks under combined temperature and train loading are analysed. The results of this paper will provide reference for establishing unified CRTS–III slab ballastless track.

**Key words:** CRTS–III; slab ballastless track; combined temperature and train loading; static behavior
The Technical Challenges of Cross-sea Bridges in China

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ABSTRACT

Different from bridges over rivers, cross-sea bridges face more severe natural conditions, e.g., strong wind, saline water, complicated hydrodynamic environments caused by the wave-current interaction in the estuary or coastal sea areas. The difficult construction situations of three famous cross-sea bridge projects in China, i.e., Donghai Bridge, Hangzhou Bay Bridge and Zhoushan Island-
Mainland Connection Project and the corresponding precious experience of technical challenge are described. The major factors, such as typhoon/strong wind, ship collision and pile scour, for the technical challenges of cross-sea bridges are inferred from a case study of Zhoushan Island-Mainland Connection Project. The results show considerable experience has been accumulated through the design and construction of cross-sea bridges in China in the last two decades. However, continuous attentions, health monitoring and technical challenges are still necessary for the risk of strong wind, ship collision and pile scour, because the increasing tendency of building cross-sea bridges father from the coastline may lead to higher possibility of stronger wind and more sever pile scour, as well as the gradually growing ship number of water transportation may raise the probability of ship collision to cross-sea bridges.

KEYWORDS: cross-sea bridge; strong wind; pile scour; ship collision
Improving Transfer Feasibility for Older Travelers Inside High-speed Train Station

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ABSTRACT

There were 0.21 billion elderly people in China by the end of 2014. Moreover, it is predicted that elderly travelers will reach approximately half a billion by 2053 in China (CRCA, 2014). To gain insight for transfer feasibility between different modes for elderly passengers passing through specific barriers in the metropolitan high-speed train stations, 716 valid samples of older travelers (aged 60 and older) were collected about their experience at the Beijing High-speed Railway Station in
In the research, transfer feasibility is specifically defined as their experience with entering the station to board the train and disembarking from the train to access the other travel modes. Nineteen specific barriers were studied and classified into three categories based on their degrees of seriousness and commonness, which were evaluated by the surveyed senior adults. Comparing the quantitative links between each barrier and travelers’ information, in terms of personal characteristics, physical conditions, psychological features, and traveling characteristics, over the three groups indicate that: (1) health condition rather than chronological age mattered in transfer ability; (2) most male and female respondents insisted on or preferred an independent long-distance trip (however, females were more likely to be impacted by transfer barriers); (3) seniors were susceptible to subjectively exaggerate transfer deficiency and carry anxieties before the experience; (4) although there is a general decrease, the serious barriers will be unalterable without suitable measures. As a conclusion, appropriate solutions, such as providing travel training service, priority service, variety humanity facilities, infrastructure optimization, and charged private service are proposed to improve the transfer environment, long-distance mobility, as well as wellbeing of the older adults in train stations.

Keywords: Older travelers; Aging; Transfer feasibility; Train station; Behavior; Improvement
城市轨道交通可达性计算方法

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摘 要: 轨道交通是城市客运系统的骨干，可达性是公共交通合理性评价的重要指标，客观准确的评价轨道交通可达性，对轨道-常规公交换乘衔接调整，轨道站点周边用地规划等都起到重要的决策支撑作用。通过对传统可达性概念的总结，结合轨道交通系统自身特点，对轨道交通可达性进行了定义。从轨道交通与常规公交换乘便利性和轨道交通自身站点间通达便利性考虑，建立了轨道交通可达性计算模型。借助ArcGIS、TransCAD等工具，以北京市轨道交通为例，计算了北京市轨道交通可达性分布状况，对比分析了北京地铁14号线中段开通前后轨道系统可达性的变化状况。结果表明，该方法能够客观准确的计算轨道交通可达性值，可以很好的应用在轨道交通可达性评价中。

关键词: 城市交通; 轨道交通; 可达性; 公交接驳; 线路换乘; 地理信息系统

中图分类号: U491.1

A Calculation Method of Urban Rail Transit Accessibility

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Abstract: Rail transit is the backbone of urban passenger transport system, and the accessibility is an important index for evaluating the rationality of public transport. An objective and accurate methods to calculate the value of urban rail transit accessibility, can provide an important support for adjusting the transfer convenience between metro and bus transit, and the land use planning surround the subway station. This paper defines the urban rail transit accessibility based on traditional accessibility concept. And establishes the calculating model based on transfer convenience of rail transit and bus transit.
And then using GIS and TransCAD, this paper calculates the accessibility of Beijing rail transit. The accessibility between and after the middle section the line 14’s opening are compared and analyzed. The result shows that the proposed method can calculate the urban transit accessibility objectively and accurately, it can be used to evaluate the service level of rail transit.

**key words:** urban traffic; rail transit; accessibility; bus transfer; metro line transfer; GIS
综合客运枢纽信息设置影响行人行为的调查分析

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摘 要：在分析综合客运枢纽信息内涵及作用的基础上，根据不同的分类标准对综合客运枢纽信息进行了分类。枢纽内行人对信息有需求，枢纽信息的设置才会对行人有影响；因此，分别从不熟悉枢纽环境的进站行人、出站行人、换乘行人3个方面详细分析了枢纽内不同走行路径的行人对信息的不同需求。最后，通过对上海虹桥火车站实地调查，并对调查数据进行分析，得出在换乘过程中设置快速路径指示标识和实时信息都将影响枢纽内换乘行人的行为，并建议在地铁换乘高铁的A/B方向通道上，规范信息设置，凸显指路信息。

关键词：综合客运枢纽；调查分析；信息；行人行为

中图分类号：U291.7+5

Investigation and Analysis of Pedestrian Behavior Influenced by Information in Integrated Passenger Transport Hub

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Abstract: This paper studies on the pedestrian behavior influenced by information during a transfer in integrated passenger transport hub. The field investigation method is applied. The connotation, purpose and function of information in integrated passenger transport hub is analyzed firstly. In the hub, the pedestrians need information to guide directions, so the information can affect them. Different demand of pedestrians have different travel paths. Shanghai Hongqiao Railway Station is analyzed as an example of the investigation. Results show that the pedestrian behavior can be influenced by setting up a fast-track information and real-time information during a transfer. Some countermeasures and
suggestion of information setting is presented in this paper.

**Keywords:** integrated passenger transport hub, investigation and analysis, information, pedestrian behavior

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Research on Uneven Wear Prediction Model of Monorail Running Wheel Based on SVM network

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ABSTRACT

According to the tire wear model and combined with the influence factors of partial wear, characteristics of partial wear of running wheel on straddle monorail vehicle is proposed. On the basis of the experimental and kinetic simulation method, the sample data of the partial wear characteristic of the runner wheel are obtained. Based on the support vector Nonlinear regression algorithm is established, and the support vector machine (SVM) model is established. The cross validation algorithm is used to optimize the penalty factor and kernel function parameters. Based on the parametric optimization of the support vector machine (SVM) model, the characteristics of the design parameters and the variation of the suspension parameters of the monorail are predicted. The results of SVM model simulation show that the support vector machine (SVM) prediction model based on cross validation can predict the trend of partial wear of the running wheel more accurately, and provide the theoretical basis for the design of the monorail.

KEYWORDS: Monorail vehicle; Running wheel partial wear; Nonlinear regression algorithm; SVM model; Prediction
Research on Coordination Using of Tracks at Different Terminals in High-speed Railway Hub

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ABSTRACT

In this paper, the coordination using of tracks at different terminals in high-speed railway hub is focused on. In particular, it is known that the rational division of labor of high-speed station in rail hub is of great significance to the coordination using of hub transportation resources. In addition, considering the track equipment in high-speed railway terminals is different, the division of labor plan of high-speed railway station and the utilization plan of the track yard need to be combined to optimize. Firstly, the operational requirements of electric multiple units are analyzed. Based on the analysis, the need for coordinated optimization is got and confirmed. Next, the optimal method of the traffic path of the EMU trains is applied to build the coordination and optimization model of division and track application of the high-speed rail hub in this paper. In the model, the capacity constraint of the hub rail lines and the service capacity constraint of tracks are considered. What’s more, to better solve the model, the algorithm core of the CPLEX is developed by C# software. In the end, Zhengzhou high-speed railway hub is taken as a real-world example, and the optimal division of labor of Zhengzhou high-speed railway hub is got. Further, the capacity utilization of different track yards between the actual and optimal division is compared from the qualitative and quantitative aspects. In this way, the effectiveness of the model and algorithm is verified, and the optimal results can provide a certain degree of decision to support hub expansion.

KEYWORDS: High-speed rail hub, division of labor of high-speed station, application plan of tracks, traffic path optimization, CPLEX
Research on Line and Station Designing of Modern Tram

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Abstract: Ground track is commonly applied to the modern tram, whose line position and location of stations impact both the safety and efficiency of urban transportation. This paper addresses types of line laying and station selection, and analyzes the advantage and disadvantage of others types of line laying and station selection. The result is: (1) Considering the influence of the transportation during constructing and traffic organization, the center line outperforms the nearby line; (2) station selection depends on road resource, type of line and passenger attract, and different sites can have different options, taking account of surrounding situations. The research results can make sense and provide technical guiding for the design and construction of the modern tram.

Key words: modern tram; line; station; road
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基于序优化蚁群算法的列车运行调整问题研究

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摘 要: 为了评价蚁群算法在有限时间内所得优解的质量,基于序优化方法提出了一种改进的蚁群算法使用盲目挑选规则选择初始解,并对信息素进行相应的初始化; 确定得到满足要求的优解所需要的迭代次数, 将其作为算法的终止条件; 为了更好地利用每次迭代中的优解, 在算法开始阶段使用前 l 个迭代优解更新信息素, 以增强探索能力; 在算法结束阶段采用当前迭代最优解更新信息素, 以加快收敛速度。改进算法在保证收敛的前提下, 并没有增加算法的时间复杂度。将这种方法运用于列车运行调整中, 得到优质解, 改进算法在解的质量和收敛速度方面优于最大-最小蚂蚁系统。

关键词: 蚁群算法; 序优化; 盲目挑选; 列车运行调整问题

Research on Train Operation Adjustment Based on Sequence Optimization Ant Colony Algorithm

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Abstract: To evaluate the quality of optimal solutions obtained by the ant colony optimization (ACO) algorithm in limited time, an improved ACO algorithm is presented on the basis of the ordinal optimization. An initial solution is selected using the blind picking rule, and the pheromone is initialized correspondingly. The number of iterations to achieve the optimal solution meeting the demand is then determined and is used as the termination condition of the algorithm. To make better use of the solutions obtained at each iteration, the first l solutions are employed to enhance search capability at the beginning phase of the algorithm. While the current optimal solution is used at the end phase of the algorithm to accelerate the convergence. The time complexity of the novel algorithm is not increased under the condition that ensures the convergence. Apply this method to train operation adjustment, get
high quality solutions. The improved algorithm is superior to the maximum - minimum ant system in terms of the quality and convergence speed of the solution.

**Keyword:** antcolony optimization; ordinaloptimization blind picking; train operation adjustment problem

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基于乘客均衡候车的城市轨道交通线路多站协同限流建模与仿真

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摘 要: 城市轨道交通大客流呈现非均衡、非稳态、非线性特征，直接影响乘客服务水平和列车运行可靠性。本文综合考虑列车运行特性与乘客到达规律，以各站乘客均衡候车为优化目标，构建线路层车站间的协同限流模型，并基于MATLAB非线性规划fmincon函数进行求解。通过算例分析表明，该方法能从线路大客流均衡管控的角度缓解运能与运量之间的矛盾，具有有效性和合理性。

关键词: 城市轨道交通; 大客流; 均衡候车; 多站协同; 限流

Modeling and Simulation of Multi-station’s Co-passenger Flow Control Based on Waiting Time Equalization in Urban Rail Line

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Abstract: The large passenger flow of urban rail transit presents unbalanced, unsteady and non-linear characteristics, which is the main factor influencing the passenger service level and reliability of train operation. According to the train running characteristics and ridership arrival regulations, this paper presents co-passenger flow control model between multi-stations in a single line, aiming to balance the passengers’ waiting time of each station. Then, the fmincon function provided by MATLAB is designed and used to solve the model and find the optimal value. Finally, the analysis of a simulation case shows that the model is effective and reasonable to alleviate the contradiction between transport capacity and traffic volume from the angle of equal control of mass passenger flow.
key words: Urban Rail Transit; Mass Passenger Flow; Waiting TimeEqualization; Multi-Stations Coordination; Flow Control

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Optimization of Inbound Container Distribution Organization in Rail-water Transhipping Terminal

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ABSTRACT

Rail-water transportation is an important component of intermodal transportation system. Effective operation of rail-water intermodal transportation requires not only railway network and advanced handling equipment, but also scientific and reasonable transportation organization. In
this paper, we first briefly introduced the coordination area and related concepts. Then an inbound container distribution organization model (ICDOM) was established, considering many factors such as transhipping capacity, network capacity and the timeliness of containers etc., to minimize the total container-hours in the coordination area, which reflected the efficiency of inbound container distribution organization. Additionally, a genetic algorithm (GA) was developed and an evaluation method based on transportation organization’s comprehensive benefits was established to evaluate the optimization results. The results showed that the model and algorithm were effective.

**KEYWORDS:** Intermodal transportation, Railway operation and management, Distribution organization, Genetic algorithm