ABSTRACTS of Ph.D. THESES

Selected abstracts of Ph.D. theses submitted at Russian transport universities.
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Benkovich, N. I. Improvement of algorithms for traction drive control of diesel locomotives with asynchronous electric motors. Abstract of Ph.D. (Eng) thesis [*Sovershenstvovanie algoritmov upravleniya tyagovym privodom teplovozov s asinkhronnymi elektrodvigatelyami. Avtoref. dis... kand. tekh. nauk*]. St. Petersburg, PGUPS publ., 2020, 16 p.

The main goal of the work is to improve the control algorithm of an autonomous voltage inverter (AVI) of a traction power converter for asynchronous electric motors of a diesel locomotive, which ensures a decrease in dynamic losses in AVI, an increase in traction and anti-slipping properties of a locomotive.

The following tasks were solved:

• theoretical comparison of existing algorithms for generating output voltage of a two-level inverter and determining necessary requirements for their improvement;

• improvement and research using a computer model of the algorithm for direct digital regulation of phase currents of asynchronous traction motors with an adjustable switching frequency of power semiconductor devices;

• improvement of the anti-slippage and skid protection algorithm for locomotive wheelsets;

• development of a method and equipment for monitoring dynamic processes in a traction electric drive;

• bench and operational tests of developed algorithms as part of the traction converter automatic control system.

A technique and software have been developed for measuring and recording the electromagnetic moment of an induction traction motor under conditions of real operation of diesel locomotives.

The use of a modified algorithm with improved dynamic properties made it possible to increase traction and anti-slipping properties of a locomotive.

To measure and store experimental data, a specialized high-frequency recorder was developed, which provides continuous (within five days) recording of sixteen analog parameters on an SD memory card with a frequency of 2 kHz. To process the measured results, we used WinPOS and MatLab software packages. The computer mathematical model was assembled in the SimuLink software package.

Specialty 05.09.03 – Electrotechnical complexes and systems. The work was carried out at Emperor Alexander I Petersburg State Transport University.

Denisov, I. A. Substantiation of parameters of metal structures of cargo bogies of bridge-type cranes on the basis of a universal layout scheme. Abstract of Ph.D. (Eng) thesis [*Obosnovanie parametrov metallokonstruktsii gruzovykh telezhek kranov mostovogo tipa na osnove universalnoi komponovochnoi skhemy. Avtoref. dis... kand. tekh. nauk*]. Bryansk, BSTU, 2020, 22 p.

The objective of the study was to improve cargo bogies of general-purpose bridge-type cranes through the use of new design solutions and design approaches in determining the parameters of their supporting metal structures.

A mathematical model has been developed for the structural-parametric synthesis of the load-bearing metal structure of a general-purpose bridge crane truck on the basis of a universal layout diagram of a modular configuration with the possibility of its structural recombination during operation.

In the course of the work, regularities of influence of the position of mechanisms of a cargo bogie, designed on the basis of universal layout diagrams, on distribution of support loads between its running wheels were established.

Basic universal layout diagrams of load-bearing metal structures of cargo bogies for general-purpose bridge cranes of complex and modular configuration have been developed, which allow to reduce total metal consumption of bogies while maintaining strength, stability and stiffness indicators.

The features of the use of a frequency-controlled electric drive during its operation in operating modes of crane mechanisms were experimentally studied. Based on the study, recommendations are given on development of design combinations of loads acting on the metal structure of a cargo bogie. In addition, recommendations were formulated for setting up systems of a frequency-controlled electric drive of crane mechanisms, considering the dynamic and energy performance indicators in different modes of their operation.

A method for designing a metal structure of a cargo bogie of a general-purpose bridge crane is developed based on a universal layout diagram of a complex and modular configuration.

Based on the proposed universal layout schemes, design solutions have been developed for load-bearing metal structures of cargo bogies for general-purpose bridge cranes, protected by Russian patents No. 175918, No. 178169, No. 185448.

Specialty 05.05.04 – Road, construction and hoisting-and-transport vehicles. The work was carried out at Bryansk State Technical University. The defense took place at Moscow Automobile and Road Construction State Technical University (MADI).

Isakov, T. A. Automation of regulation of passenger traffic during large-scale cultural events. Abstract of Ph.D. (Eng) thesis [*Avtomatizatsiya regulirovaniya passazhiropotoka pri provedenii krupnomasshtabnykh kulturno-massovykh meropriyatii. Avtoref. dis... kand. tekh. nauk*]. Moscow, RUT, 2020, 24 p.

When planning large-scale cultural events (LSCE), tasks related to timely and safe arrival and departure of large numbers of people are key ones for organizers. In the period of global digitalization, it is effective to determine quality of transport infrastructure operation using digital twins, simulation models. When choosing algorithms for automated regulation of passenger traffic during LSCE, it is necessary to conduct simulation experiments to obtain numerical values of selected control quality criteria and to select a control method that provides the required values of control quality criteria.

One of the aspects of solving the problem refers to definition of algorithms and methods for automated regulation of passenger traffic during LSCE, the choice of mathematical apparatus and software for development of simulation models of LSCE, considering changing parameters.

Transport infrastructure and regulation of pedestrian flows during LSCE was chosen as the object of the research, while algorithms and methods of automated regulation of passenger traffic during LSCE were considered as the subject of research.

The purpose of the thesis was to develop the structure and mathematical support of an automated system for regulating passenger traffic during LSCE (ASRP).

The requirements for ASPR have been formalized, which made it possible to synthesize the structure and many models of this system.

The LSCE classifier has been compiled, which makes it possible to determine the composition of objects and their associations considered when planning LSCE: zones of delimitation, planning levels and a list of controlled objects, which made it possible to decompose the tasks facing the organizers.

Based on the analysis of statistical data, differences in behaviour of participants in the pedestrian flow of spectators, the specificity of their interaction with each other were revealed, which made it possible to consider the pedestrian flow as heterogeneous and identify client groups in its composition.

These results made it possible to adequately model the behaviour of pedestrian traffic participants during LSCE.

A method for automated regulation of passenger traffic during LSCE was developed, considering the criteria for quality of management of the transport infrastructure of LSCE.

The study of the object in all zones of delimitation was carried out during construction of mathematical models, resulted in a formalized description of the behaviour of client groups of pedestrian traffic arising in the simulated space.

A simulation model of functioning of delimitation zones during LSCE was created, considering, in contrast to the already known, heterogeneity of the pedestrian flow, the differences in the criteria for assessing quality of functioning of service systems in different delimitation zones.

The analysis of the results of simulation modelling was carried out, which made it possible to formulate standard recommendations for achieving the target values of quality criteria for regulation of passenger traffic.

The analysis has been carried out that makes it possible to use existing scientific approaches, methodologies, methods for processing data obtained during the study during preparation for LSCE and to formulate the requirements for the structure and functionality of ASRP.

The levels of planning and delimitation zones during LSCE have been revealed. Depending on their combinations, this makes it possible to distinguish client groups in the pedestrian flow and the infrastructure facilities involved, which is important for solving problems of regulating passenger traffic.

A classifier has been compiled that allows to identify particular tasks of regulating passenger traffic, typical for a specific group of activities, and to select quality criteria for functioning of infrastructure facilities.

The composition of mathematical support of ASRP has been determined, which makes it possible to solve the problems of automated regulation of passenger traffic during LSCE.

A graphical interpretation of the structural diagram of the service system is presented, which allows solving many problems of planning transport processes when carrying out LSCE in a single information space.

A mathematical model of a pedestrian flow in various delimitation zones has been created, considering the inclusion of client groups, which allows solving the problems of safe planning and functioning of infrastructure facilities.

Simulation models of transport infrastructure have been developed, considering the presence of client groups as part of the arriving passenger traffic at LSCE, allowing to solve the problems of safe planning of functioning of transport infrastructure and pedestrian flow in the last mile zone before and after LSCE.

Recommendations on organization of passenger traffic and the operating mode of transport infrastructure facilities of LSCE are formulated. The effectiveness of proposed control methods was fully confirmed during comparison of the results of simulation modelling and field experiments, including matches of the 2018 FIFA World Cup.

Specialty 05.13.06 – Automation and control of technological processes and production (transport). The work was carried out at Russian University of Transport.

Oshorova, V. V. Development of proposals to restrain operation of individual vehicles in a busy part of the city during the period of the highest traffic density. Abstract of Ph.D. (Eng) thesis [*Razrabotka predlozhenii po ogranicheniyu ekspluatatsii individualnykh transportnykh sredstv v zagruzhennoi chasti goroda v period naibolshei plotnosti transportnogo potoka. Avtoref. dis… kand. tekh. nauk*]. Moscow, MADI, 2020, 25 p.

Restraining operation of vehicles with minimization of losses, costs, resources in conditions of a limited street-road network (SRN) is an urgent scientific and practical task.

The aim of the study is to reduce loss of time of road users and environmental damage (caused by the excess of transport demand for operation of individual vehicles over the capacity of SRN).

The object of the study was the transport demand for operation of individual vehicles in large cities. The subjects of research were speed, density and traffic intensity of vehicles under the conditions of traffic congestion, changing depending on application of fiscal regulation of transport demand for operation of individual vehicles.

The scientific novelty consisted in development of theoretical and methodological provisions for restraining of operation of individual vehicles during the periods of the highest traffic density in the busy part of the city:

- identification of the target function of restraints on operation of individual vehicles and the criterion for selection of road sections for introduction of such restraints;
- substantiation of changes in traffic density depending on the applied tariff regulation;
- determination of a criterion for assessing the effectiveness of measures taken to restrain operation of individual vehicles, considering total costs of road users.

The theoretical and practical value of the work is that the developed scientific, methodological and practical approaches will provide the target indicators of the main traffic flow diagram and will reduce the negative effect of atmospheric air pollution in the busy part of the city; will reduce wasted time due to transport delays; will promote development and application of new technologies for positioning vehicles, and can also serve as a theoretical basis for formation of transport demand in the context of fiscal regulation, and for development of appropriate regulatory legal documents.

The results of the research were introduced into the educational process of MADI technical university in lecture courses of the discipline «Basics of logistics» that is part of training in 03.03.02 «Management» study programme.

The results of the study were considered and introduced into the practices of St. Petersburg State Public Institution «Directorate for Traffic Management of St. Petersburg» by using them for preparing feasibility materials for further analytical materials on substantiation of a tolled entrance to the central part of St. Petersburg.

Specialty 05.22.10 – Operation of road transport. The work was carried out at Moscow Automobile and Highway State Technical University (MADI). ●