ABSTRACTS OF Ph.D. THESES

Selected abstracts of Ph.D. theses submitted at Russian transport universities

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Ermolenko, I. Yu. Computational and experimental methodology for assessing the interaction of wagons and the track on mountain crossing sections. Abstract of Ph.D. (Eng) thesis [*Raschetno-eksperimentalnaya metodika otsenki vzaimodeistviya vagonov i puti na gorno-perevalnykh uchastkakh. Avtoref. dis... kand. tekh. nauk*]. Irkutsk, IrGUPS publ., 2020, 20 p.

The problem of ensuring safety of traffic on mountain crossing sections of the track is not sufficiently disclosed now. This statement is based on many publications of leading scientists and prominent specialists who have been working for many years in the field of studying the dynamics of rolling stock.

The objective of the thesis is to develop technical solutions and proposals aimed at improving safety of rolling stock moving along mountain crossing sections of the track using a quantitative and qualitative assessment of operational factors affecting car derailment.

The object of the research is traffic safety and rolling stock derailments on mountain crossing sections of the East-Siberian Railway.

The subject of the research is a computational and experimental technique for assessing the interaction between a car and a track to improve traffic safety on mountain crossing sections.

A combination of theoretical, experimental, and numerical research methods was used.

The influence of the automatic coupler operation on the axle box unit failures has been established.

A computational and experimental technique has been developed for a quantitative and qualitative assessment of the influence of operational factors on safety of rolling stock movement along mountain crossing sections of the track.

As a result of investigations of car derailments and systematisation of factors affecting traffic safety violations, it was determined that derailments occurred mainly under a combination of the following conditions:

• when moving in gentle curved track sections with a radius of 800 m to 1200 m at a speed of 60–80 km/h, a lateral load occurs, which for a long time acts on the arc of the rail and may cause its rupture;

• in case of excessive lateral loads caused by jamming of the coupler shank in UP1 opening in the extreme limit position (up to 13°C).

Train tests were carried out, during which longitudinal and vertical forces acting on the car were determined when it was moving along the mountain crossing sections of the East-Siberian Railway.

The mathematical model of movement of a freight car has been clarified by considering the variable action of longitudinal forces from the automatic coupler, acting when moving along mountain crossing sections of the track and determined during train tests.

A specialized roller stand has been developed, which made it possible in laboratory conditions to simulate movement of a car with wheel faults in curved sections of the track, setting the rail elevation and the size of the defects on the wheel rolling surface.

A new rejection feature has been established for visual monitoring of jamming of the coupler shank and a method for its detection.

Technical recommendations have been developed for speed modes of cars movement for real track sections of East-Siberian Railway, a branch of JSC Russian Railways.

05.22.07 – Railway rolling stock, train traction and electrification. The work was carried out at Irkutsk State Transport University.

The defence took place at Emperor Alexander I St. Petersburg State Transport University.

Kravets, A. S. Development of methods of technological interaction of enterprises in regional systems of transportation of bulk cargo. Abstract of Ph.D. (Eng) thesis [*Razvitie metodov tekhnologicheskogo vzaimodeistviya predpriyatii v regionalnykh sistemakh transportirovki nasypnykh gruzov. Avtoref. dis... kand. tekh. nauk*]. Rostov-on-Don, RGUPS publ., 2020, 26 p.

The Russian Federation, due to its geographical features, is located at the intersection of the most important international directions of cargo flows, which determines its priorities in development of transport infrastructure, the need to develop technologies for organising the transportation process, especially in the export transportation segment. An increase in the share in the export of bulk cargo requires the search and implementation of effective transport and technological

schemes for development of this transportation segment using the potential of transport modes, including railway transport.

In these conditions, it is necessary and relevant to develop new approaches and methods of technological interaction of enterprises in regional systems for transportation of bulk cargo based on improvement of production, transport and warehouse processes and systems for distribution of freight flows.

The objective of the thesis is development of methods for organising and managing transport and technological interaction of enterprises in regional systems for transporting bulk cargo based on increasing the efficiency of control systems for distribution of freight flows, subject to rational loading of the port regional infrastructure.

The object of the research is regional transportation and technology systems (TTS) for managing bulk cargo transportation to ports, taking into account interaction of modes of transport and increasing competitiveness of transport services.

The subject of the research is theoretical and methodological approaches to functioning of systems for organising and managing transportation of bulk cargo in regional port TTS, transport, and technological schemes for transportation of bulk cargo in international traffic, logistic methods of multi-agent interaction.

The theoretical and practical significance of the work lies in development of an economic and mathematical model, methods, and algorithms for solving the problem of managing regional transport systems in terms of the technology of transporting bulk cargo by various modes of transport, taking into account customer focus, multi-agency and measures to increase competitiveness of modes of transport.

The analysis of the current state of domestic and foreign scientific experience in the field of organisation and management of bulk cargo transport processes is carried out. The analysis of technological parameters of interaction of regional entities of the transport market in the export transportation of bulk cargo with participation of modes of transport. The need for development of methods for distribution of regional cargo flows based on the principles of multi-agent and customer focus has been established.

The development of methods for choosing the forms of concentration of regional transport and storage systems in organisation of railway transportation according to the specified factors: capacity, productivity and dynamics of the cargo mass is proposed. A method of clustering the elements of the regional TTS (loading cluster – port cluster) has been developed according to the author's algorithm, which makes it possible to assess the possibilities of increasing the level of routing of bulk cargo in the region. Schemes for selection of alternatives to railway loading stations in the cluster have been developed for implementation of technical routing of bulk cargo transportation.

An economic and mathematical model has been developed for choosing a rational organisation of bulk cargo flows to ports on the basis of a developed system of temporary and economic criteria for assessing the transportation process in a multi-agent TTS, taking into account clustering of production and transport warehouse facilities and loading of port infrastructure.

An algorithm and a software package for formation of a plan for distribution (routing) of bulk cargo based on the principles of customer focus has been developed. As a result of approbation of the methodology, areas of effective interaction of loading and port clusters were obtained.

An assessment was made of effectiveness of implementation of rational plans for routing bulk cargo transportation at the North Caucasian Railway network, which allows the client to reduce transportation costs by 3,36 % (1,108 million roubles), reduce the mileage of rolling stock by 11,300 km (3,45 %), create a time reserve of 0,17 days (7,46 %) to ensure the rhythm of the transportation process in the port and within technological system. The integral indicator of quality of organisation of distribution of regional cargo flows has been improved by 13 %.

The theoretical and methodological studies carried out in the thesis work can serve as a scientific basis for formation of directions for development of regional TTS for management of bulk cargo transportation, the competitive benefits of transport enterprises. Their implementation in the transport process will ensure an increase in the efficiency of transportation systems for railway, road and water transport through the use of an economic and mathematical model and development of a parameterization system, an adequate assessment of the levels of interaction between modes of transport based on an integral indicator of quality of organising distribution of regional freight flows.

05.22.01 – Transport and transport-technological systems of the country, its regions and cities, industrial organisation in transport sector.

The work was carried out at Rostov State Transport University.

Pivovarov, D. V. Method of logical complement for organising control of combinational devices in the systems of monitoring of devices of railway automation. Abstract of Ph.D. (Eng) thesis [*Metod logicheskogo dopolneniya dlya organizatsii kontrolya kombinatsionnykh ustroistv v sistemakh monitoring ob'ektov zheleznodorozhnoi avtomatiki. Avtoref. dis… kand. tekh. nauk*]. St. Petersburg, PGUPS publ., 2020, 16 p.

The constant complication of technology, miniaturization, increased productivity, and an increase in heat transfer – all this requires development of diagnostic support.

To ensure reliability, various measures are used, such as the use of highly reliable elements, the use of backup methods, diversification and technical diagnostics, the use of self-checking logic circuits, etc. This thesis research touches on such a direction as improving approaches to the synthesis of functional control systems (SFC) of automation devices based on the logical complement method.

The main objective of the thesis research is to improve the methods for synthesizing the SFC devices of automation based on the logical complement method.

The object of the research is the SFC built on the basis of the logical complement method, and the subject is focused on the characteristics of the SFC built on the basis of the logical complement and the methods of synthesizing the SFC.

The theoretical significance of the work lies with development of empirical and functional approaches to the synthesis of SFC based on the method of logical complement to equilibrium codes, as well as with control of computations based on two features with provision of complete self-checking of structures.

The practical significance of the work is associated with the possibility of using the proposed methods for the synthesis of SFC by the method of logical complement for organisation of diagnostic support for a wide range of automation devices (from monitoring to control).

The methods of Boolean algebra, theory of discrete devices, technical diagnostics are used.

The degree of reliability of the results is confirmed by the correct use of the mathematical apparatus of Boolean algebra, the theory of discrete devices, technical diagnostics, rigorous mathematical proofs, correct calculations, as well as experimental studies with systems of control logic circuits.

In the thesis, some particular solutions to an important scientific and technical problem of the synthesis of self-checking discrete devices based on the logical complement method are proposed.

A review in the subject area of the thesis research is carried out and the main unexplored issues in organisation of functional control systems for automation and computer equipment are established.

Methods for synthesis of logical complement functional control systems based on equilibrium codes, which implement the idea of empirical and functional approaches to obtaining the values of logical complement functions, have been proposed and developed.

It is shown that the use of the logical complement method allows one to synthesise a large number of variants of functional control systems for a particular circuit, in particular, it makes it possible to obtain completely self-checking discrete devices with the redundancy, which is less than redundancy of duplication.

It has been found that the most effective and simplest to implement are methods that involve the use of constant-weight codes with a small codeword length not exceeding $n = 6$.

The use of several functional features in the synthesis of a diagnostic system by the method of logical complement is proposed and it is shown that in this case it is possible to increase the detecting ability in the main logic block with hardware costs not exceeding the costs of duplication.

The necessary and sufficient conditions for the synthesis of completely self-checking structures of functional control systems have been established, which actually focus on the impossibility of committing errors of a symmetric type at the outputs of a stage of adders referring to module two.

A method for organising a self-diagnosis system of measuring controllers for monitoring the parameters of railway automation devices is proposed, which makes it possible to control the correctness of converting signals into a digital code.

05.13.06 – Automation and control of technological processes and production (transport).

The work was carried out at Emperor Alexander I St. Petersburg State Transport University.