

## ABSTRACTS of D.Sc. and Ph.D. THESES

*Selected abstracts of D.Sc. and Ph.D. theses  
submitted at Russian transport universities  
For the original Russian text please see p. 332.*

DOI: <https://doi.org/10.30932/1992-3252-2019-17-332-335>

**Bui Shi Han. Algorithms for processing radar data in automotive collision avoidance radar systems. Abstract of Ph.D. (Eng) thesis [Algoritmy obrabotki radiolokatsionnykh dannykh v avtomobilnykh radiolokatorakh preduprezhdeniya stolknoveniya transportnykh sredstv. Avtoref. dis... kand. tekhn. nauk]. Moscow, MAI publ., 2019, 21 p.**

A new algorithm for estimating the parameters of radar images (RI) of road objects has been developed, which makes it possible to effectively determine the sizes of central sections of RI of road objects (standing and moving) during the movement of automotive radar systems (AMRS). This algorithm allows to automatically monitor the studied object, which eliminates the need for manual measurement of its parameters.

The dimensions of the central radar sections of RI of cars are estimated, allowing to determine the dimensions of cars on the road depending on reflection characteristics.

The dependence of cross sections of RI of a passenger car on the angle when driving on the road is estimated, showing a small dependence of dimensions of the central cross sections of cars when observing cars at a small angle of up to 14°.

The developed algorithm for determining road boundaries shows the efficiency in processing of RI with borders having metal fences. It is shown that this algorithm also works with other curbs. This gives a driver an opportunity to assess the position of a car with AMRS when driving on an unusual road in conditions of poor visibility.

The error in determining the road borders in a panoramic AMRS is estimated, which seems acceptable for a road with a metal fence and a protective curb of 1 m.

A new algorithm for improving the quality of RI visualization on the AMRS monitor screen has been developed, based on the use of radar extension in the polar coordinate system. It is shown that the application of the obtained algorithm makes it possible to increase the information content on the state of objects on the road, which provides a driver with an opportunity to evaluate positions and dimensions of objects like a visual representation of a perspective.

Processing of real signals shows the effectiveness of the developed algorithms. The measurement errors of the cross-sectional dimensions of car models are on average less than 15%. With metal road fences, the algorithm for determining road boundaries works with an error of up to 1,5 meters.

*Specialty 05.12.14 – Radar and radio navigation. The work was performed at Moscow Aviation Institute (national research university).*

**Fyodorova, V. I. Improving the profile of wheel rolling surface for heavy wagons. Abstract of D.Sc. (Eng) thesis [Sovershenstvovanie profilya kataniya koleasa dlya tyazhelovesnykh vagonov. Avtoref. dis... dok. tekhn. nauk]. St. Petersburg, PSTU, 2019, 16 p.**

A set of studies was carried out aimed at increasing the resource of wheels in operation for heavy cargo cars with an axial load of up to 25 tf.

Review and analysis of main malfunctions of wheels of cargo cars, the geometry of wheel rim profiles developed and operated in Russia and abroad, the methods for optimizing the rim profiles of wheels, as well as criteria for assessing the dynamic performance and interaction of rolling stock and track are made.

Based on the results of measurements and determining the rate of wear of rolling surface and wheel flange with a profile in accordance with GOST [State Standard] 10791, operated in cargo cars on bogies 18-9855, the need to reduce the wear rate in the rolling circle, as well as eliminating the running-in period, was established.

Models have been developed: wheel and rail profiles, approximated by Bezier spline 4 orders of magnitude, ensuring their smoothness, used for further calculations of the kinematics of the wheel set and the car dynamics; kinematic models of interaction of the wheel set and the track, allowing to calculate the function of difference of the radii of wheels of the wheel set, the equivalent taper, the position of contact areas during lateral movement of the wheel set; a computer model of carriage movement developed in MEDYNA software package, refined by a representative section of the track; finite element model of a set of wheels with a portion of the track for calculating contact pressure and equivalent stresses arising from interaction of the wheel with the rail, allowing us to study the effect of lateral movement.

Based on the developed models, a method was proposed for choosing the rational geometry of the wheel profile for heavy cars, which allows to build a smooth non-linear surface of the wheel profile, which reduces wear in operation without formation of contact spalling.

Using the methodology, an improved profile of the wheel rim was developed, which differs from the profile according to GOST 10791 as it has a curved surface with three radii of curvature on the ski surface of 500 mm, 325 mm and 87,5 mm, respectively, from the rolling circle to the ridge.

Comparison of the improved profile paired with R65 rail in the new state showed that it provides a smooth transition from the rolling surface to the fillet zone, the contact is displaced from the center to the ridge and has a predominantly elongated transverse contact spot shape, which reduces wear.

Using computer simulation, the influence of the wheel profile on the performance of a cargo car and wheel wear was studied, and it was found that when using the developed profile, the frame forces are reduced by 14,9 %, and the safety factor from wheel derailment is increased by 30,1 %, there is no significant effect on the dynamic additive coefficients.

*Specialty 05.22.07 – Rolling stock of railways, traction of trains and electrification. The work was performed at Emperor Alexander I St. Petersburg State Transport University.*

**Lunyov, A. A. Justification of calculated values of mechanical characteristics of ash and slag mixtures for design of roadbed. Abstract of Ph.D. (Eng) thesis [Obosnovanie raschetnykh znachenii mekhanicheskikh kharakteristik zholoshlakovykh smesei dlya proektirovaniya zemlyanogo polotna. Avtoref. dis... kand. tekhn. nauk]. Omsk, SibADI, 2019, 22 p.**

The mathematical model proposed by R. Olson for formation of the stress state arising in the soil of roadbed due to the effect of transport load was modernized by taking into account the structural features of the ash and slag mixture (ASM), its density, influence of dead weight of the road structure and the nature of application of the transport load. The resulting model adequately reflects the results of a pilot test.

The regularities of influence of the following factors on strength and deformation characteristics of the ash-slag mixture have been experimentally established: humidity and density of this material; content of slag fraction (heterogeneity of these technogenic soils in ash dumps); the number of short-term cyclic loads from action of vehicles.

The values of the Poisson's ratio, the California number of bearing capacity of ASM at various degrees of compaction and humidity of this technogenic soil are determined. Mathematical dependencies are derived that reflect the relationships between the elastic modulus obtained by the stamp test method and the lever press method, the secant elastic modulus obtained from triaxial tests, the compression deformation modulus, and the California bearing capacity number.

The experimentally determined regularities made it possible to derive regression equations suitable for predicting the values of parameters of the mechanical characteristics of ASM under the conditions of actual operation of roadbed embankments.

Based on the data obtained, structural and technological solutions have been developed for design of roadbed embankments from ASM.

The results of experimental and theoretical research and the proposed structural and technological solutions passed pilot production testing at two large facilities (transport interchanges with embankments made with ASM up to 15 m high in Moscow region).

*Specialty 05.23.11 – Design and construction of roads, subways, airfields, bridges and transport tunnels. The work was performed at Siberian State Automobile and Highway University.*

**Pisarenko, V. V. Choice of rational parameters of units and parts of running gears of car bogies. Abstract of Ph.D. (Eng) thesis [Vybor ratsionalnykh parametrov uzlov i detalei khodovykh chastei telezhki vagonov. Avtoref. dis... kand. tekhn. nauk]. Moscow, RUT, 2019, 24 p.**

Mathematical dependencies are described that describe operation of the Universal Mechanism software package. In addition, mathematical dependences of force interaction of design of the 18-100 model bogie and guide rollers were derived. Mathematical studies of the law of wheel sliding along the rail head were conducted.

The new mathematical model allows to study the physical laws of interaction between parts and assemblies of the modernized model 18-100 bogie, without resorting to full-scale tests, to evaluate safety of movement, to evaluate volumetric wear of wheel sets and other friction pairs. Additionally, it is possible to use this model to determine optimal geometric dimensions, inertial and force parameters of this model.

A mathematical model of movement of a truck of a bogie 18-100 model of a cargo car on a curved track section is derived.

A methodology has been developed for determining rational geometric and strength characteristics of support beams, guide rollers, and also an elastic element for damping vibrations in the design of the model 18-100 bogie with guide rollers installed.

Based on the results of the assessment, it can be concluded that installation of guide rollers on the base bogie of model 18-100 led to a significant improvement in several indicators.

As a result of calculations by Archard's methods, it was determined that installation of guide rollers to a greater extent affects wear of wheels. The volumetric wear of wheels of the upgraded bogie relative to the base bogie of the model 18-100 decreases by 34 %, and, accordingly, the overhaul mileage will increase by 34 %.

The economic effect and payback period of modernization were also determined. According to the above calculations, the payback period was 2 years.

*Specialty: 05.22.07 – Rolling stock of railways, traction of trains and electrification. The work was performed at Russian University of Transport.*

**Shmanyov, T. M. Method of increasing stability of compliance with the schedule of passenger trains. Abstract of Ph.D. (Eng) thesis [Metod povysheniya stabilnosti soblyudeniya grafika dvizheniya passazhirskikh poezdov. Avtoref. dis... kand. tekhn. nauk]. SPb.: PGUPS, 2019, 16 p.**

A method has been developed for assessing the compliance with the train schedule (TS) for passenger trains, determining an approach to the analysis of its stability on the basis of consideration of changes in the patterns of violation of TS, establishing a method for controlling stability of the indicator of compliance with TS by dynamically adjusting the reserves of TS.

A model is proposed for formation of target standards for the level of compliance with TS of passenger trains, based on identification of quantitative patterns of changes in the characteristics of violations of the main network, as well as a method for observing the passenger trains under the conditions of patterns of changes in the characteristics of trains, including minimizing the consequences of violations by dynamically adjusting the schedule reserves.

*Specialty 05.22.08 – Management of transportation processes. The work was performed at Emperor Alexander I St. Petersburg State Transport University.*

