

Railway infrastructure diagnostics
for safety and comfort



HEADQUARTERS



27 Nikulinskaya st.
119602, Moscow



+7 495 230-30-26



tvema@tvema.ru

Production and Training Center

24 Ugreshskaya st.
109088, Moscow
Tel.: +7 495 789-86-54
tvema@tvema.ru

Service department «EAST»

1 Traktovaya st.
664020, Irkutsk
Tel.: +7 952 634-02-67
petrikovec@tvema.ru

Hong Kong

19/F., Tien Chu Commercial Building
173-174 Gloucester Road
Wan Chai
Tel.: +852 68404465
china@tvema.com

India

ADJ Engineering Pvt. Ltd.
C-23, Sector 88, Noida
U.P 201305
Tel.: +91 1204911681
info@adjengineering.in

Ukraine

Galaktika-Test, LLC
12 Chigorina st.
01042, Kiev
Tel.: +380 443615041
galactica-test@ukr.net



RAILWAY DIAGNOSTIC SYSTEMS AND SOLUTIONS

www.tvema.com



President
Vladimir Tarabrin

AO «Firma TVEMA», a private company, founded in 1989, is the world leader in the development, production and support of the systems for the railway infrastructure diagnostics. The company is the only manufacturer in the world that has in its product range all types of tools for the track superstructure and overhead line diagnostics. It performs the full scope of work on the design, production and maintenance of these tools.

COMPANY ACTIVITIES

The company's headquarters, production, maintenance and training centers are located in Moscow, the branch offices operate in Fryazino and Irkutsk, and the regional offices are opened in Ukraine, China and India.

The company has more than 300 employees, almost half are engineers of various profiles. The production and maintenance center with an area of more than 8 thousand square meters includes access tracks, repair and maintenance shops, office and laboratory facilities, indoor and outdoor sites. The center fully meets the requirements of international quality management systems — the general ISO 9001 and the industry-specific IRIS.

Nowadays, dozens of railway companies and subways worldwide operate approximately 390 mobile and over 4,000 hand-held and portable diagnostic tools manufactured by TVEMA. Our innovative products and technologies successfully operate in more than 30 world countries on 5 continents. The company's products can be found on the railways of Russia and Germany, Czech Republic and France, USA and Brazil, Canada and Slovakia, Finland and Bulgaria, Romania and Serbia, Israel and Hungary, Turkey and Mongolia, China and India, Guinea and Libya, Ukraine and Belarus, Kazakhstan and Kyrgyzstan, Turkmenistan and Armenia, Latvia and Estonia. Our products are used in Moscow, St. Petersburg, Novosibirsk, Nizhny Novgorod, Minsk, Almaty, Baku and Beijing subways, at industrial enterprises of large Russian companies: Gazprom Neft, LUKOIL, Severstal, Coal Company Severny Kuzbass, Metalloinvest Holding. Among our clients are the Baikonur

and Plesetsk spaceports and even the children's railway in the city of Novosibirsk.

For about three decades, TVEMA has cooperated with Russian Railways. At the same time, the company made many of its developments in close cooperation with Russian Railways, and on the basis of its decisions made by the order of the Russian government. Products of the TVEMA brand make up three quarters of the all-Russian fleet of mobile diagnostic tools and more than 50% for the CIS countries. Non-production activities worth special noting. For example, a certified "Center for Training of Specialists in Technical Diagnostics" is operating in Moscow. Since 2009, over 7,000 representatives of railways and subways of Russia and foreign countries have been trained here. The developed technical support service and its own personnel training center allow the company to ensure not only the quick commissioning of even the most sophisticated equipment, but also its further trouble-free operation.

By deciding to cooperate with us, you can be sure that the operation of your railway infrastructure facilities will become safer and more efficient.

TEST, MEASUREMENT AND DIAGNOSTIC SYSTEMS AND SOLUTIONS

The railway industry is a special area with increased safety requirements, the guarantee of which is the consistency and complexity of the relevant diagnostics and control. TVEMA is a world leader in the development and supply of test, measurement and diagnostic products for checking the railway infrastructure condition in order to ensure its safety. The creation and supply of such products is a priority for the company, and they themselves make up the bulk of the total range of its products.

TVEMA systems and solutions allow the whole range of test, measurement and diagnostic operations at railway infrastructure facilities, including flaw detection, inspection of track and rail profile geometry parameters, video inspection of track superstructure elements, spatial scanning of facilities, measurement of contact network parameters, ground penetrating radar survey of roadbed.

All our developments are universal in application and allow to carry out both rapid and high-speed, and manual inspection. Due to their integration and interchangeability, they can be used individually and in combination with each other, for one or several types of verification of different facilities. The modular design of our systems allows to install them in any combination and configuration on various carriers — from portable diagnostic tools installed on trolleys to multifunctional diagnostic trains. Also, all our products are united by all-weather and all-season operability, and all data obtained with them are synchronized within a single software with combinatorial analysis and processing.

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HIGH-SPEED ULTRASONIC FLAW DETECTION SYSTEM

With increasing speeds and the number of trains, the occupancy factor also increases, which forces an increase in the ultrasonic testing speed and leads to a decrease in its reliability. Based on the vast development experience, we created a unique high-speed ultrasonic rail inspection solution.

PRODUCT PURPOSE AND COMPOSITION

The solution provides rail flaw detection and recording by the ultrasonic non-destructive testing method in the speed range from 0 to 140 km/h without reducing the testing reliability.

The mechanical components are located directly on the bogie of car between wheels and consist of a non-contact magnetic guidance system; detection system; pneumatic system and couplant supply system. The device is based on the principle of modularity, which simplifies the equipment installation on a vehicle and replacement of its components during their modernization.

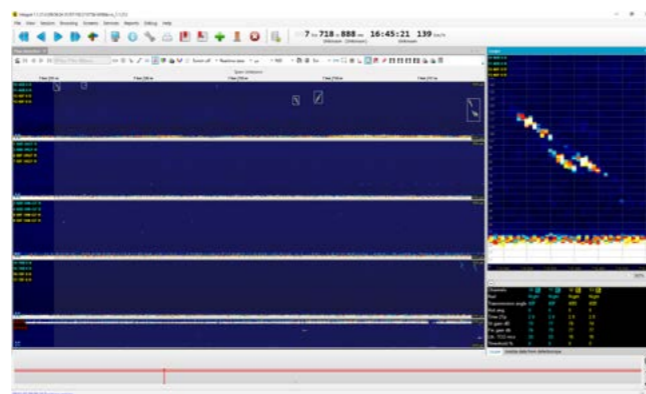
The non-contact guidance system ensures accurate positioning of detection systems against the rail axis due to the interaction of its permanent magnet magnetic fields with the rail field.

The sliding detection system consists of probe units, the design of which allows to implement any probe configuration. The unit transducers emit ultrasonic waves with different turning angles to the rail head gauge and field faces, which allows to implement monitoring without dead zones.

The couplant supply system provides an uninterrupted supply of water, that can be heated to carry out inspections even at low temperatures.



Multichannel flaw detector ECHO-COMPLEX-3. Distinctive features of the flaw detector are: an increased number of ultrasonic channels, the use of the latest solutions in the field of circuitry and an expanded range of control software functions. All of the above makes it possible to apply a new inspection technology that allows to overcome the speed barrier previously unattainable for ultrasound.



SOFTWARE

The software implements inspection data presentation in accordance with customer requirements. All received information is processed in real time, recorded and documented for further analysis and planning of works on the routine maintenance and repair of the track.

SCOPE OF APPLICATION

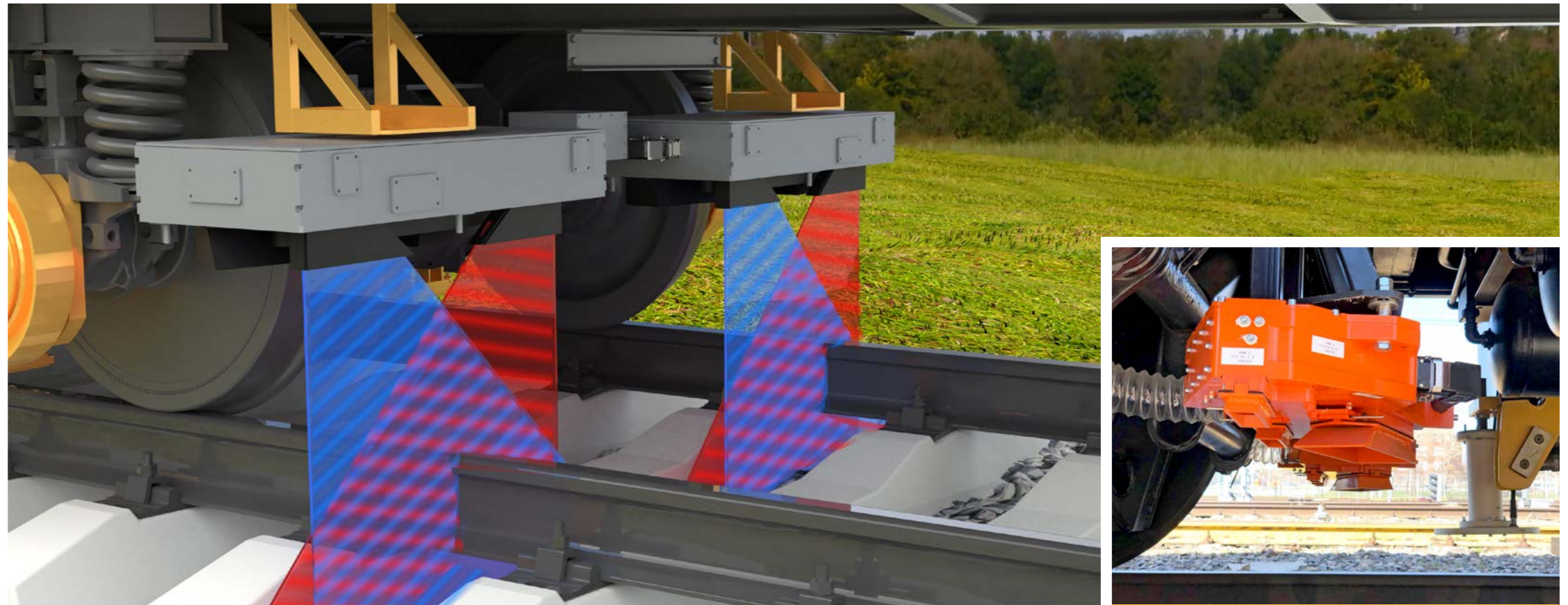
The network of railways and subways.

ADVANTAGES

- Monitoring speed up to 140 km/h.
- Use of sliding detection systems.
- Simple design.
- High reliability level exceeding 95%.
- Unobstructed passage of any turnouts.

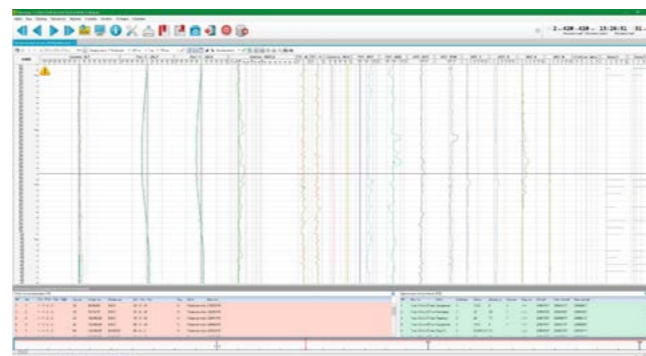
HIGH-SPEED RAIL PROFILE AND TRACK GEOMETRY MEASUREMENT SYSTEM

The track geometry measurement system uses optical triangulation sensors in combination with the inertial navigation system (IMU). Such a combination of measurement equipment made it possible to build a system that can be installed on almost any diagnostic tool, including hybrid road-rail vehicles and even trolleys, and is able to operate in one cross-section, unlike chord systems, and also make high-precision measurements at speeds up to 250 km/h, since there is no contact with the measured facility — the rail.



PRODUCT PURPOSE AND COMPOSITION

An installation scheme of dual triangulation units per rail is used to obtain a complete rail head profile. Due to the three-dimensional cameras monitoring the rail external side, it is possible to assess its wear and all the necessary additional parameters from an external non-gauge face. The installation of dual triangulation units provides a single line of illumination by the main and additional lasers, which allows to increase the power, intensity and quality of their radiation and provides an automated analysis of the track superstructure elements from the internal and external rail side. Equivalent conicity monitoring with a full rail profile monitoring system allows maintaining the proper level of traffic safety at high-speed railway sections. The system uses double laser illumination on both sides of the rail, which makes it possible to increase the intensity of the reflected laser radiation into the measuring chamber. To combat rain, snow, dust, etc., pre-cleaned air is supplied in front of the optical profilometer glass under pressure.



SOFTWARE

The modular INTEGRAL software collects, displays and analyzes data and forms output lists. It has a distributed architecture, which allows you to physically and/or logically separate the client and server parts, group measurement systems in any configuration and flexibly configure the automated workstations of operators in terms of the displayed data.

SCOPE OF APPLICATION

The network of railways and subways.

ADVANTAGES

- High testing speed (up to 250 km/h).
- Compact, lightweight and simple design.

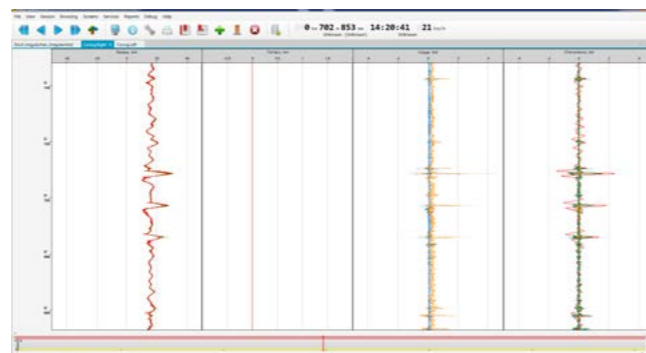
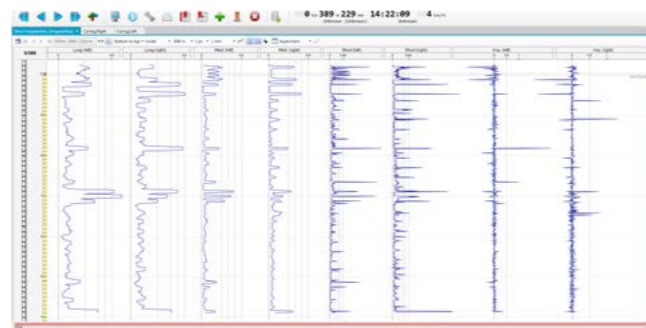
RAIL CORRUGATION MEASUREMENT SYSTEM

The rail corrugation in the form of periodic irregularities on the rail head leads to intense noise, impairs the train movement smoothness and reduces the track superstructure and rolling stock element service life. To determine this flaw, in 2018, we created a system for the rail corrugation measurement. Having several integration interfaces, it, if necessary, can be integrated into the existing vehicular measuring system.



PRODUCT PURPOSE AND COMPOSITION

The device is designed to collect data on the rail head corrugation depth and length during the movement along the surveyed track section. The system includes measuring modules for high-precision measurement at a wide range of speeds. The modules are installed on a car bogie, one on each side. Their centering is carried out with permanent magnets, which direct the whole system and position the sensors to ensure measurement accuracy. Compressed air is used to protect the system optical windows from dirt and dust. Computer equipment is installed in a server rack inside a vehicle.



SOFTWARE

All obtained information on the parameters of the identified deviations from the maintenance standards is processed in real time, recorded and documented for further analysis and planning of works on the routine track maintenance and repair. The software generates output forms in tabular and graphical displays for all parameters and issues customizable measurement reports. For irregularities in each of the measured ranges, the number of threshold value excesses for the selected profile, the average RMS amplitude value and the average RMS error amplitude value are calculated. The percentage excess ratio for these values is also calculated.

SCOPE OF APPLICATION

The network of railways and subways.

ADVANTAGES

- Performing direct irregularity measurements.
- High accuracy and speed of measurements (up to 160 km/h) according to the standards of both the Russian Federation and EN in the wavelength range from 0.15 m to 3.5 m.
- Non-contact magnetic tracking system.
- Ability to integrate into the existing measuring system of a vehicle.

VIDEO MONITORING SYSTEM

In order to automate the process and eliminate the “human factor” influence on the results of periodic inspections of infrastructure sections, we have created the video monitoring system. It is a hardware and software solution for monitoring railway infrastructure with the ability to output and store video recordings of the received image in specialized software.

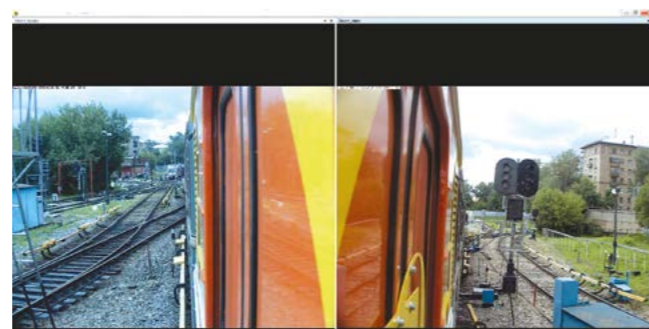
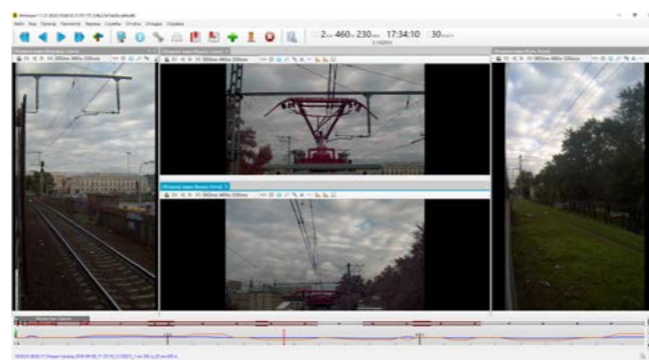
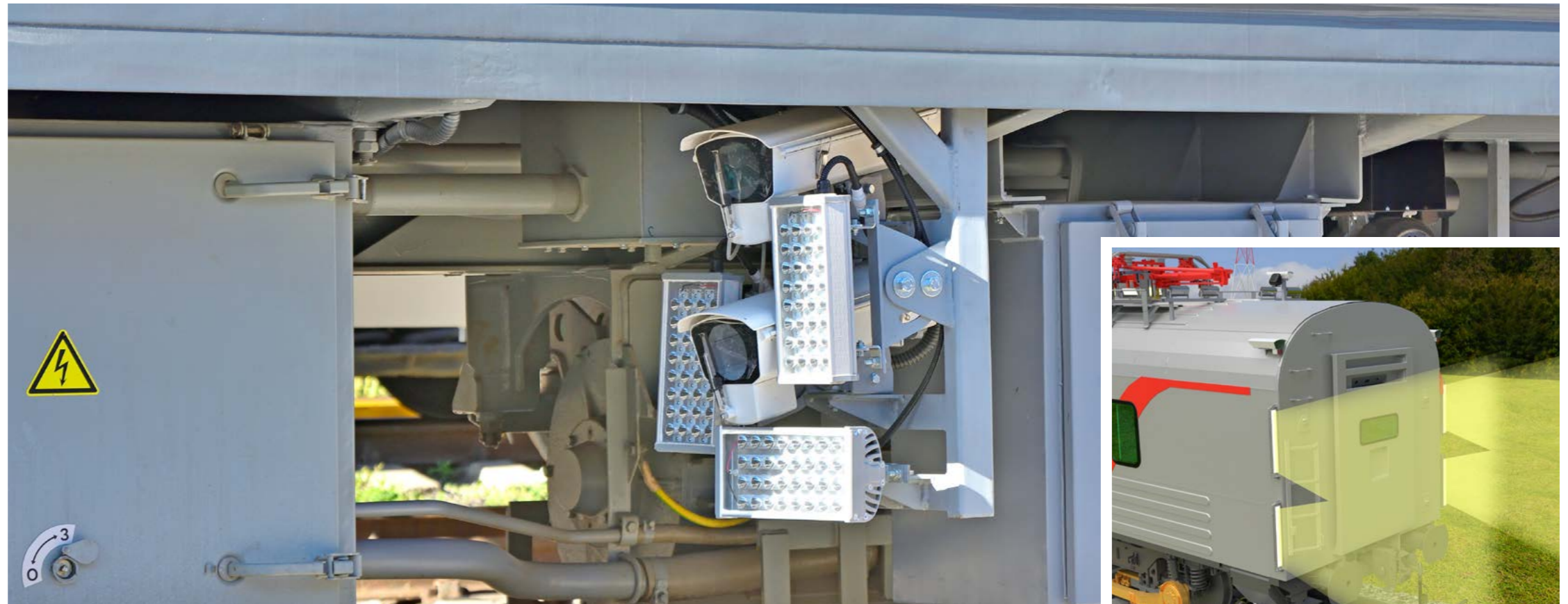
PRODUCT PURPOSE AND COMPOSITION

The system is designed for railway infrastructure monitoring and control during the measuring train movement and allows the operator to locate places where an emergency can occur due to the damage or lack of any element.

The system can be installed on any vehicle and allows to perform:

- continuous monitoring and visual control of all railway infrastructure facilities;
- recording and processing of high-resolution images from cameras installed on a vehicle.

The equipment design allows to place it both on the car body, and on various types of bogies. For more efficient operation, the system can be equipped with systems for heating, dust extraction, mechanical cleaning and washers for external glazing. All received video data is precisely linked to the track and geographic coordinates.



SOFTWARE

The software implements the monitoring data presentation in accordance with customer requirements. All received information is processed in real time, recorded and documented for further analysis and planning of works on the routine maintenance and repair of the track. It is also possible to compare the obtained data with the data of other diagnostic systems installed on the mobile unit.

SCOPE OF APPLICATION

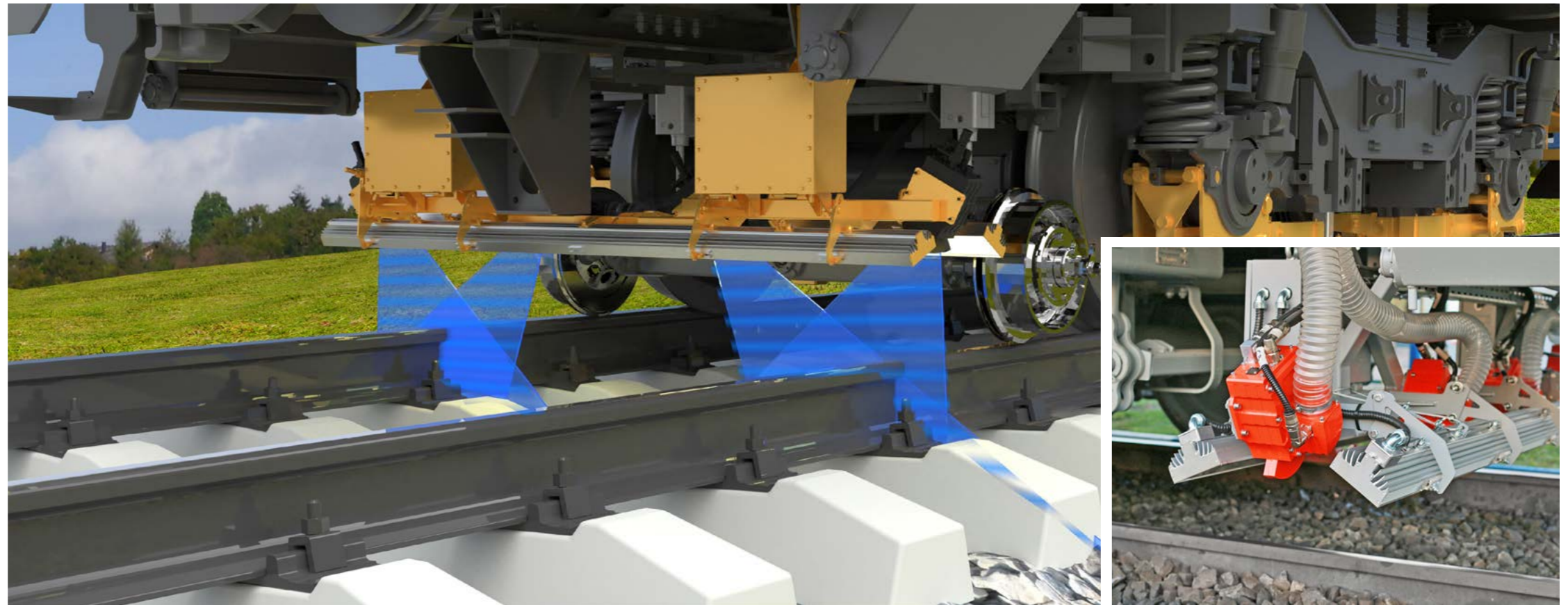
The network of railways and subways.

ADVANTAGES

- High monitoring speed.
- Automatic switching of day/night modes.
- High photosensitivity.
- Operation in a wide range of temperatures.
- Efficient lighting system that guarantees sharp image at very short shutter speeds of the camera.
- Compact, lightweight and simple design.

TRACK VIDEO INSPECTION SYSTEM

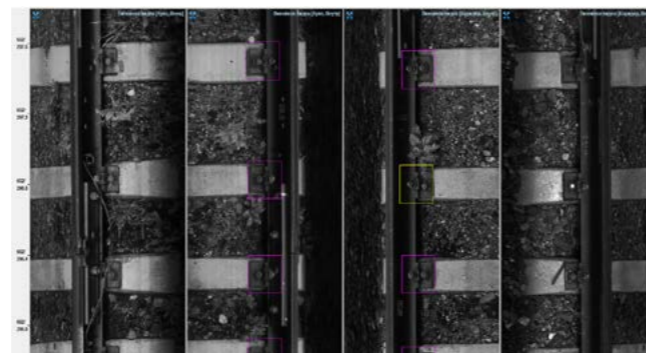
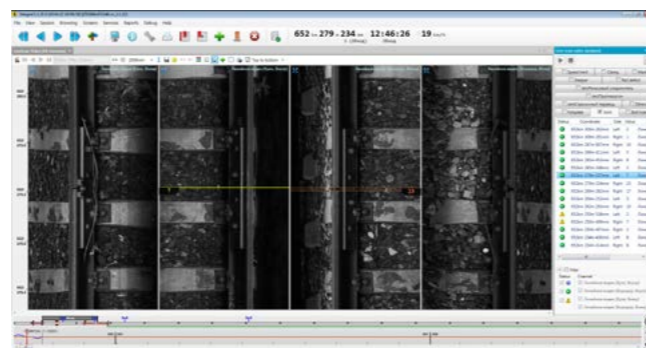
In order to improve the quality and optimize the railway track superstructure element inspection by increasing the operating speeds, we have created the track video inspection system.



PRODUCT PURPOSE AND COMPOSITION

The system is designed for automated visual monitoring of the track superstructure element condition and real-time post-processing of the obtained data. One of the system main components are high-speed linear cameras capable of high-resolution shooting in the speed range from 0 to 250 km/h.

The system operating principle is based on the visual detection of the track superstructure element surface flaws with linear cameras. The resulting image is digitized and transmitted via a high-speed interface to the server, where data is recorded for later evaluation. The system allows real-time and post-processing monitoring of missing bolts, fish plate condition, joint gaps, fastener flaws, rail fastener and sleeper condition, surface rail flaws, rail bar displacement against the guide sleepers. The equipment design allows to place it on the bogie and survey the track superstructure elements within the whole width of sleepers. For more efficient operation, the system is equipped with a blowing system using compressed air. All received video data is precisely linked to the track and geographic coordinates.



SOFTWARE

Analytical software allows to solve a number of problems in identifying flaws in infrastructure, depending on the customer needs. The data recording and analysis system provides real-time lossless image compression, increasing the autonomous session period without data archiving. It is possible to compare the obtained data with the data of other diagnostic systems installed on the vehicle.

SCOPE OF APPLICATION

The network of railways and subways.

ADVANTAGES

- Automated analysis of the track superstructure element flaws with up to 95% reliability.
- High speed monitoring in real time.
- Track monitoring for several parameters simultaneously.
- Operation in a wide range of temperatures.
- Compact, lightweight and simple design.
- Advanced identification of places with a possible threat to traffic safety.

OVERHEAD LINE PARAMETER MONITORING SYSTEMS

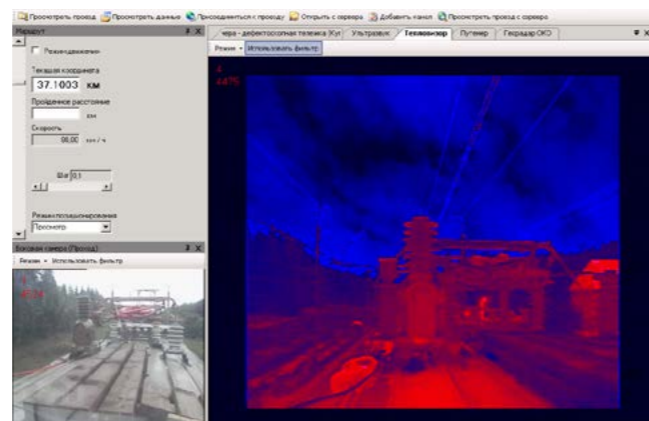
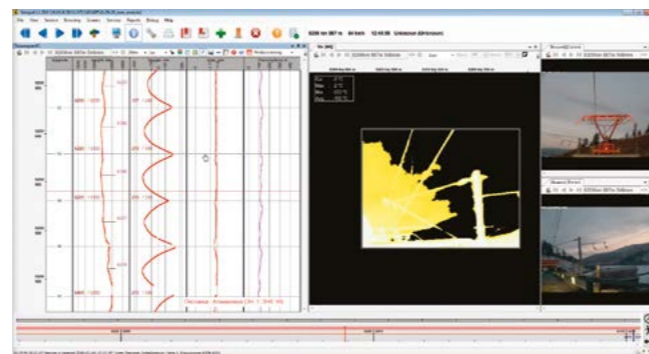
To maintain normal operating parameters of the electrified railway overhead lines, their continuous inspection with special monitoring and diagnostic systems is necessary.

PRODUCT PURPOSE AND COMPOSITION

Overhead inspection and diagnostic equipment includes: an optical overhead geometry measurement system; overhead line wear measurement system; measuring current collector; IR and UV diagnostic systems; video inspection system providing all-round view; the steady brace height and support dimension determination system; car body tilt compensation system; support grounding monitoring system (both single and group ones); compensator weight position monitoring system and other auxiliary systems.

Catenary and overhead line geometry rapid monitoring system

The catenary and overhead line geometry rapid monitoring system is one of the company's latest developments. The main geometric parameters of the overhead line, such as height and zigzag, are measured in non-contact manner using an optical triangulation system. The ability to simultaneously inspect up to 8 lines is implemented. The measuring system auxiliary components, which are installed optionally, allow to monitor the line lowering on the aerial frogs, the steady brace pin height, and record hits on the current collector, pressing on the current collector slide and bouncing from it, determine the presence of faulty insulators and overheating suspension components of the overhead line, conduct video recording of the infrastructure condition, and other important parameters of the overhead line elements.



SOFTWARE

The data obtained during the travel goes to the on-board control and computing system, which provides visualization, recording and automatic analysis of parameters with the identification of deviations from the maintenance standards. The processed measurement results are displayed in real time in the form of graphs at the operator's workstation and are archived on the hard disk or portable drives. Based on the inspection results, a package of reporting documentation is formed, and a point estimate of the inspected overhead section condition is calculated in accordance with the current regulatory documentation.

SCOPE OF APPLICATION

The network of railways.

ADVANTAGES

- High speed of the measuring system — up to 250 km/h.
- Optical and mechanical methods of preventing solar exposure.
- Direct measurement of the overhead line wear area with an error of maximum 0.1 mm.
- Measurement of the overhead line and pantograph interaction characteristics.
- Modular system architecture allowing to flexibly configure it.

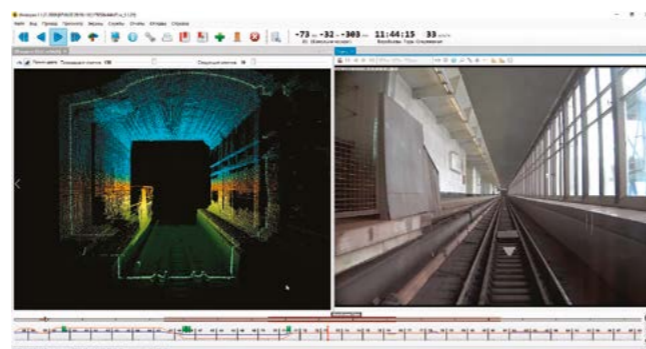
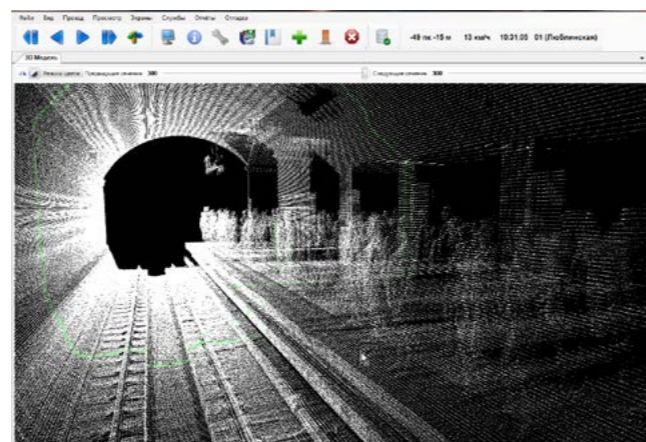
HIGH-SPEED CLEARANCE MEASUREMENT SYSTEM

One of the most laborious tasks in the conditions of growing speeds and volumes of cargo transportation is the maintenance of tunnels and artificial structures. To facilitate the fulfillment of the tasks of diagnosing these facilities, we have developed the high-speed clearance measurement system.



PRODUCT PURPOSE AND COMPOSITION

The system combines from 1 to 6 high-speed laser scanners that provide impressive results and a minimum distance between the survey cross-sections while maintaining a high point cloud resolution. Due to the system, it is possible to measure infrastructure facilities at speeds from 0 to 250 km/h year-round. High equipment accuracy and manufacturing quality make it possible to achieve at high speeds the minimum measurement error in the entire operating range. The system integration capabilities provide sharing of scan data and information from video monitoring and track measuring tools. The system can be used on high-speed rail lines without track time allocation for infrastructure inspection.



SOFTWARE

The innovative filtration and compression system allows to use only the really necessary information, and smart data analysis algorithms and modules of integration with customer information systems allow to quickly integrate our measuring systems into the diagnostic technology used by the customer. All received information is processed in real time, recorded and documented for further analysis and planning of works on the routine maintenance and repair of the track. The program modules form analytical and reporting data on the violations of obstruction clearance, width of distances between tracks, outlines of the ballast section and the roadbed, oversized railway platforms.

SCOPE OF APPLICATION

The network of railways and subways.

ADVANTAGES

- High monitoring speed.
- Unique software that has no counterparts in the world.
- Operation in a wide range of temperatures.
- Compact, lightweight and simple design.

MFV PROJECT MULTIPURPOSE RAILCARS

The universal railcar platform was created as a perfect base for various measurement system.

PRODUCT PURPOSE AND COMPOSITION

One of the main purposes of the MFV project multipurpose railcar is being a platform for placing various-purpose systems for railway infrastructure diagnostics. The MFV railcar can also act as a vehicle for inspections and as a means of track crew delivery to the work place at railway infrastructure facilities.

The MFV railcar is equipped with a modern heating and air conditioning system, an autonomous power supply system, fire safety system and other life support systems that fully comply with international standards of heat, vibration and noise insulation, which makes it ideal for long-term crew accommodation in autonomous conditions. The railcar is equipped with a power system, which ensures its movement by rail at a speed of 160 km/h and the operation of all its energy consumers.

The railcar modification series includes:

- Multifunctional self-propelled diagnostic solution for comprehensive railway infrastructure diagnostics. Various inspection and diagnostic systems can be installed on it at the customer request.
- Inspection railcar for inspection by the managers of railway companies, equipped with video surveillance and inspection systems and other necessary equipment.



— Passenger and freight railcar for comfortable transportation of track crews to the work place at infrastructure facilities. The railcar is equipped with utility equipment for eating, clothes drying and carrying out hygienic procedures, has a storage for the necessary tools and a room for track crew accommodation.

Interior configuration options allow the customer to choose the railcar configuration for specific task. Nowadays, the MFV project railcars of various modifications are operated on 11 railways of Russia.



SOFTWARE

The special INTEGRAL software synchronizes the operation of all diagnostic systems of the railcar, records and processes their signals and allows centralized monitoring and control of the operation of all jointly operating subsystems. Such unparalleled methodology provides a high degree of coordination and integration of actions of all monitoring elements.

SCOPE OF APPLICATION

The network of railways.

ADVANTAGES

- Versatility.
- All systems are united by a single software.
- Operation in a wide range of temperatures.

DIAGNOSTIC SOFTWARE AND HARDWARE

One of the ways to increase the economic efficiency of applied monitoring and diagnostic tools is to merge existing separate software products into a single integrated solution.

PRODUCT PURPOSE AND COMPOSITION

INTEGRAL software

Various monitoring and diagnostic systems are used to monitor the track condition, they use their own algorithms for data collecting, processing and displaying. Reducing such informational variety to a single generally understandable form is solved by the INTEGRAL software for railroad track infrastructure analysis. It manages all diagnostic systems and is a unique tool for conducting effective measurements and data processing. The software package allows to manage the work of all jointly operating subsystems. Such unparalleled methodology provides a high degree of coordination and integration of actions of all monitoring elements.

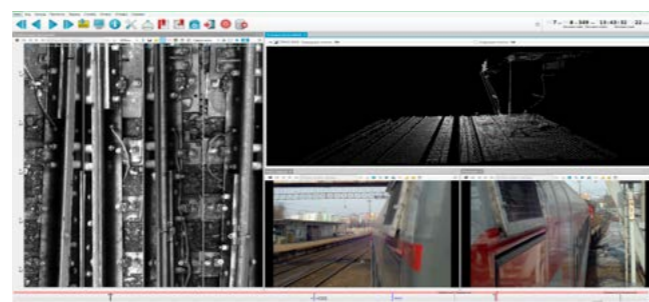
It consists of a server part and automated operator workstations with equal rights, the quantity of workstations is determined only by the convenience of use and the needs of the operating organization.

The server part consists of different, but coordinately operating, modules for data recording and processing. Such a scheme allows to expand the package functionality as much as you like by simply adding new modules. The package is installed on all mobile diagnostic tools manufactured by AO «Firma TVEMA».



Integrated automated system for combinatorial data analysis CASCADE

CASCADE allows comprehensive monitoring, analysis and forecasting of the railway infrastructure condition, and joint processing of basic and additional data received from various diagnostic systems of automated monitoring. The return on the CASCADE system implementation is mainly related to the technically justified planning of the railway infrastructure repair and maintenance and the efficient distribution of the necessary resources. Thus, CASCADE allows to switch from a planned preventive maintenance system to a system of repairs according to the actual infrastructure condition.



Module for automated evaluation of data from flaw detection tools ASTRA

The ASTRA module is designed for automated evaluation of measurement data coming from various NDT and TD tools. Using the ASTRA module as part of the INTEGRAL software allows to optimize the monitoring frequency and reduce the costs of the rail bed repairs associated with rail breaks due to a flaw being skipped by the operator and decoder. The ASTRA module has successfully passed acceptance tests at Russian Railways and is recommended for implementation on the railway network.

SCOPE OF APPLICATION

The network of railways and subways.

ADVANTAGES

- Recording, processing and display of data received from all diagnostic systems is carried out in a single software.
- Modular configurable software architecture.
- Ability to simultaneously view data obtained by several diagnostic systems within a single workstation.
- Simple and intuitive interface that allows to quickly learn how to work with software.
- Regular updates aimed at improving performance and meeting user wishes.