IK NEWSLETTER
Advanced Rail Technologies

INSTYTUT KOLEJNICTWA
IK - Railway Research Institute

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IN THIS ISSUE

Editor’s

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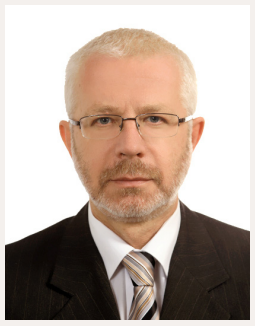

I am pleased to inform you that from the beginning of 2015 a new bimonthly newsletter from IK (Railway Research Institute) under the title of "Advanced Rail Technologies Newsletter" will be published. We intend to provide you with up-to-date information on the most remarkable events related to IK, which for over 60 years has been developing rail technologies and is a notified body (No. 1460) for Directive 2008/57/EC. By reading our newsletter, you will learn about R&D activities performed at IK and we will promote our monographs, presentations at railway conferences, and articles published in numerous domestic and international journals. The newsletter will be published in English.

You can access it online at www.ikolej.pl.
Print issues will be sent to selected entities in Poland and abroad.
We hope that this publication will be warmly welcomed, and encourage you to join us.

IK test track in Warsaw

Testing Pendolino trains

IK, as a body authorized to perform comprehensive tests of railway vehicles, during 2013 and 2014 tested the Pendolino ED250, which had been bought by PKP Intercity S.A. During the first stage of testing at the test track center near Żmigród, tests were carried out on, among others, brakes, electric and electromagnetic compatibility, interoperability with the control command and signaling equipment, and with the contact line system. Subsequently, as part of test drives at a speed of 250 km/h performed at the Central Rail Line under the supervision of the IK, an attempt to reach the maximum speed was made. On November 24, 2013, this resulted in a new railway speed record in Poland: 293 km/h.

This is also a railway speed record for this Alstom's structure.
Based on the IK research, the Polish Office of Rail Transport allowed the Pendolino ED250 for use. Since December 14, 2014, passengers may take it on several key railway lines.

ED250 (Pendolino)

InnoTrans 2014

IK has been participating in InnoTrans in Berlin for many years. Participation in InnoTrans and the promotion of our services globally are important elements of the Institute's development process, show our strength on the international market and constitute a unique opportunity for networking. We have the possibility to analyze the market as well as to compare the offer, price and quality of our services with those of other research institutes. Last year our specialists took part in numerous talks, meetings, and fair-related events.
During the trade fair, Andrzej Toruń, PhD. Hab. received the award for an innovative approach that he took in his doctoral dissertation regarding the modeling of control command and signaling processes and the application of the public standards of open networks, which are a particular example of practical solutions arising from scientific research.

InnoTrans 2014 in Berlin

3rd International Scientific Conference

On November 18-19, 2014, the third recurring International Scientific Conference, "Advanced Rail Technologies," took place. The conference was organized by IK and the Faculty of Transport of Warsaw University of Technology, and was a platform to exchange ideas related to various aspects of rail transport.
It aimed to present the achievements of scientific and research centers, both national and international, dealing with the implementation and operation of modern technologies related to rail transport.

The conference was attended by the representatives of universities, research institutes, public administration authorities, railway companies, and railway manufacture and services enterprises. The next conference will be held this November and we invite you to take part in it.

Advanced Rail Technologies Conference
November 2014

Method of train location in the rail traffic control process

Andrzej Toruń
Head of the Railway Traffic Control and Telecom Division

Traditional control command and signaling systems of rail traffic were based on mechanical, electromechanical and finally electronic devices supporting fixed and wireless telecommunications. The development of telecommunications by means of wireless data transmission enables the application of its selected techniques in the implementation of a new method of train location.

The author proposed in his doctoral dissertation the following thesis:

Applying selected techniques of wireless data transmission enables the implementation of a new method of train location.

In order to prove this, the author carried out a series of analyses pertaining to the possible uses of information technology in the control command and signaling process, e.g. presenting operational scenarios of managing rail traffic on the basis of the proposed location method, estimating how the use of the GNSS system affects the precision of location tracking, and conducting simulations involving changes in transport capacity on a real railway track.

The author's research, which exploits the mathematical apparatus of homogeneous, stationary, ergodic Markov processes, is based on self-developed models of control command and signaling processes in the traditional interpretation (complying with the principle of a "fixed block section") that describe the proposed train location method allowing for the introduction of a "moving block section" principle without the need to replace the existing railway infrastructure (control command and signaling systems).

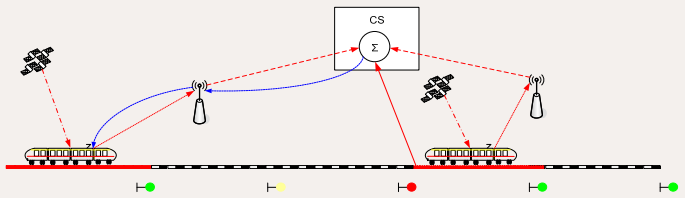

Fig. 1 New train location method

In order to verify the impact of the proposed location method on the control command and signaling system, the author carried out simulation research on the basis of the developed models of control processes. The research was carried out in the MATLAB&SIMULINK environment, SimEvents module. The impact of the proposed location method on the transport capacity of the railway line was verified by means of simulation research with reference to a real railway track (CMK Psary – Góra Włodowska).

The research was carried out in the SYM_POC software designed specifically for this purpose. SYM_POC is a train simulator written in the Borland Pascal programming language (version 2006 in the WINDOWS system environment) in an application for supporting the visualization of Rapid Application Design processes.

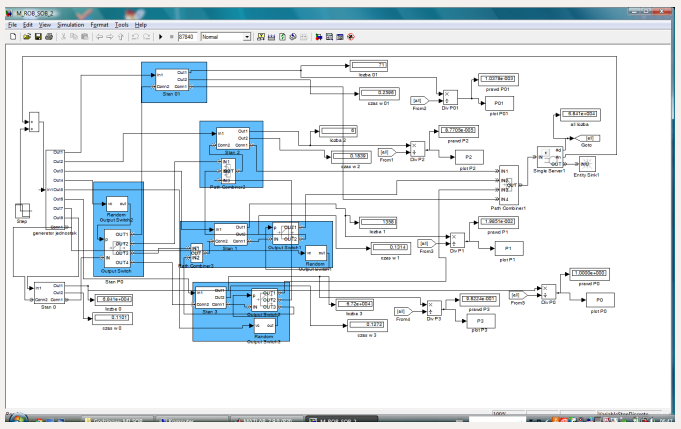

Fig. 2 Simulation model in the MATLAB environment

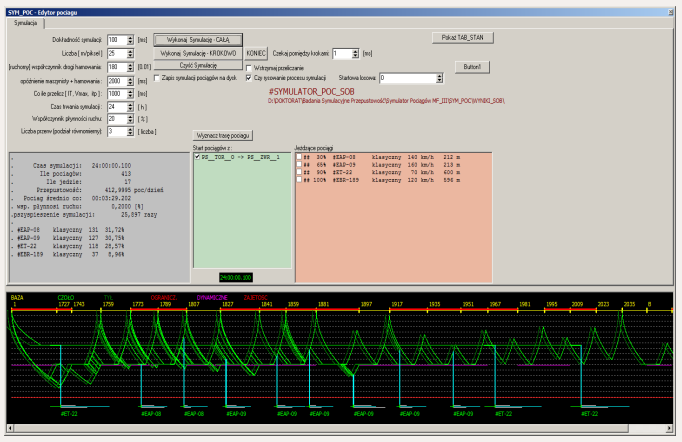

Fig. 3 SYM_POC simulation program

The doctoral dissertation entitled [transl.] "Applying selected techniques of wireless data transmission enables implementation of a new method of train location", promoter: prof. Andrzej Lewiński, PhD. Hab., Eng., defended with honors in October 2013 at Kazimierz Pulaski University of Technology and Humanities in Radom.
The dissertation is available at the Library of the Faculty of Transport and Electrical Engineering of the University of Technology and Humanities in Radom.

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The interaction between the pantograph and the overhead line at high speeds

Michał Głowacz
Engineering and Technical Specialist
Electric Power Division

The presentation discussed the criteria for the qualitative assessment of pantograph-overhead line interaction. The testing methods applied by the IK Electric Power Division were listed.

The presentation discusses practical problems encountered during tests of the pantograph system and the overhead line. In a case study of research conducted by SNCF, the French national railway company, the author indicates the differences between the modern conditions of carrying out test drives at high speeds and the standards from 60 years ago in terms of pantograph-overhead line interaction. Moreover, the presentation compared the conditions of the test drive at a speed of 331 km/h carried out by SNCF in 1955 with the conditions of today's ED250 test drives at speeds exceeding 290 km/h.

A particular emphasis is put on two aspects of the issue: the permissible impact of side effects of the tests on the condition of rolling stock units or contact line system infrastructure and the minimum level of personnel safety assumed during tests. The author discusses currently used measurement methods and divides them into two groups: methods applied to measurements of the contact line system supporting structure and those applied to vehicle measurements.

Also discussed were the modern measurement methods, having been divided into on-vehicle measurement and measurement on the contact line system supporting structure. The requirements for measurement methods, mainly consisting in the necessity for electrical separation at high voltage, were enumerated. In particular, the means of communication with sensors via wireless networks and via optical fiber cables were reviewed, and the advantages and disadvantages of each were considered.

The presentation also described simple simulation methods applied in order to perform an initial assessment on the interoperability between the pantograph and the contact line system, or to determine the most favorable measurement manner, e.g. in terms of selecting the appropriate configuration of the measurement system. External confounders to be taken into account while evaluating the results of the pantograph system-contact line system interoperability tests according to Energy TSI and Rolling Stock TSI were examined.

A manner of result interpretation was presented using the example of the graphs obtained, which illustrate the results of selected test drives completed during the process of certification of ED250 trains for multiple operation. The effectiveness of modern IR video cameras, which can be mounted in any place safely and rapidly, was shown. The main task of video cameras was also presented, which involves the counting of arc gaps at the point of contact

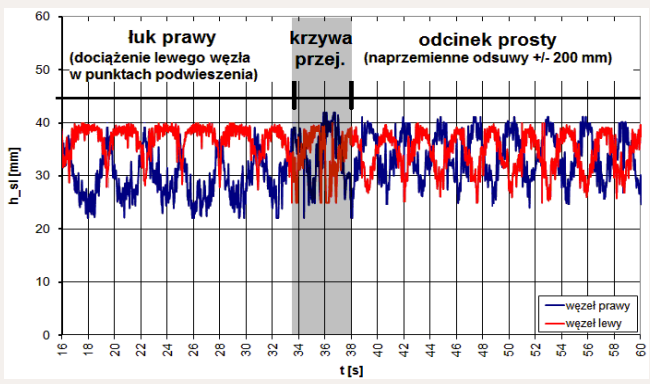

Fig. 1 Example deflections of the left and right nodes of the collector head evidenced during IK research

of the pantograph pan and the contact line system, as well as the evaluation of the dynamic movement of this contact point. A focus was placed on the significance of an easy and reliable way of video camera mounting and measuring cable feeding regarding the organization of tests and cooperation with other entities, such as carriers or manufacturers.

An emphasis was put on the practical importance of research on pantograph system-contact line system interaction, both historically and in light of the latest research on the modern high-speed rolling stock units which is conducted by the IK Electric Power Division.

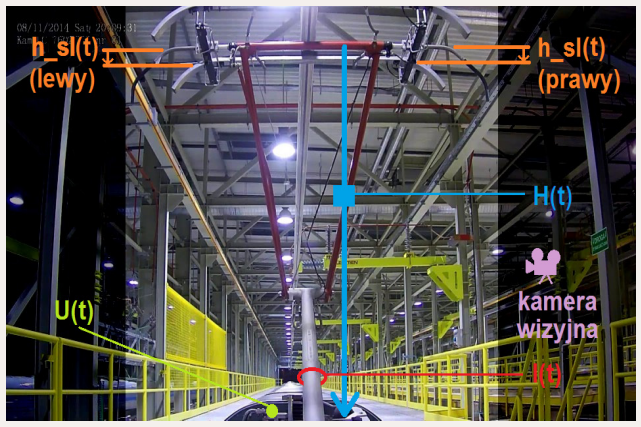

Fig. 2 Measurements taken on the vehicle, adopted as the criteria for the qualitative assessment of pantograph system-contact system interaction

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Universal design: adapting the rail to the needs of people with disabilities

Janusz Poliński
Railway Track and Operation Division – assistant professor

The monograph entitled “Universal design: adapting the rail to the needs of persons with disabilities”, published by the IK, consists of five parts and combines (1) the presentation of binding provisions and regulations regarding the removal of architectural and technological barriers within the scope of infrastructure and supra-structure, and (2) the Universal Design, which yields products not requiring further adaptation to the needs and requirements of people with disabilities

The first, general part defines the more important terms used in the text, outlines basic facts on universal design and familiarizes the reader with issues related to eyesight, hearing and movement impairments. Also discussed are the binding provisions of national and international law on amenities for people with disabilities.

The second part outlines those points of contact between rail transport facilities and other means of transport that are of importance for people with disabilities and describes the accessibility of interior infrastructure elements at the railway station.

Point of contact between the rail transport facility and other means of transport

The third part discusses in detail the rules related to adapting passenger rolling stock units in order to allow the transport of people with disabilities.

The fourth part familiarizes the reader with the accessibility of the platform-railroad car contact point and the fifth part makes reference to the specification of interoperability and the rules of its implementation.

In the conclusion, the author enumerates precisely which measures are necessary for ensuring full accessibility of rail transport to people with disabilities.

Point of contact between the platform and the railroad car

Thanks to its comprehensive approach to the issue of making rail transport fully accessible to all passengers, the monograph may be useful for technicians, designers, students, and licensed operators of passenger transport, as well as rail infrastructure managers in the sector of passenger transport, self-governmental and governmental administration, and people interested in the subject of transport, in particular in the area of rail infrastructure and supra-structure adapted to the needs of people with disabilities.

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The monograph is available for purchase from: A. Loryńska, phone: +48 22 47 31 604, alorynska@ikolej.pl

Crash test on IMPULS EMU driver's cab

Grzegorz Wysocki
Head of Dynamics Section in the Rolling Stock Testing Laboratory

Numerous areas of research expertise within the IK include crash tests on railway vehicles. The Institute has more than 20 years of experience in carrying out such tests, having completed them on the commission of many domestic and foreign manufacturers, such as PESA Bydgoszcz, Newag, CAF, Bombardier and Ansaldobreda.

Newag S.A., based in Nowy Sącz, entrusted the IK Rolling Stock Testing Laboratory with carrying out two crash tests on the driver's cab of the electric multiple unit belonging to the IMPULS family. This is the driver's cab structure used in 35WE, 31WE, 36WE, 36WEa, and 37WE vehicles as well as in newly designed 31WEa and 45WE vehicles.

The tests were carried out in November 2014 at the test track center near Żmigród, with the purpose of experimental verification the resistance estimates made to identify the crash resistance of the structure and the compliance with the crash requirements of the PN-EN 15227 standard, as well as observing the response of the driver's cab and its equipment during a real collision against the rigid wall surface of another railway vehicle.

Ram railroad car with mounted driver's cab equipped with side shock absorbers before the test

The test involved a collision of a ram railroad car, brought up to a specified speed and equipped with a built-up cab, against a rigid wall surface of a non-moving railroad car.

Measurements taken during the test involved forces and accelerations of the structure in the vertical, transverse and longitudinal directions in the moving ram railroad car equipped with the cab. Forces were measured between the frame of the cab and the railroad car wall, and accelerations at the center of gravity of the railroad car.

Additionally, accelerations in the longitudinal direction were measured in places imitating the seats of the driver and driver's assistant. Other measurements involved stresses in selected places in the cab.

Measurements taken in the non-moving railroad car included accelerations (at the center of gravity) in the vertical, transverse and longitudinal directions. Speeds of railroad cars during tests were also recorded.

Ram railroad car with mounted driver's cab after the test

Both crash tests were recorded with three high-speed cameras at a speed of 1000 FPS - one camera above and two on the sides of the collision point. The tests allowed the observation of the structure's response to collision and the determination of the level of forces, accelerations and energy absorbed. It was also verified whether enough survival space would be left for the driver, in accordance with the EN 15227 standard.

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Railway vehicle simulator

Zbigniew Szafrański
Head of Unit for Coordination of Projects and International Cooperation

In 2014, the Minister of Infrastructure and Development's regulation on centers for the training and examination of train drivers and train driver candidates entered into force, allowing the use of railway vehicle simulators for training. Therefore, it became necessary to design a reference model of the simulator for railway vehicle operators that would precisely and unambiguously define the requirements to be met by the examination simulator. The Polish standard of the railway simulator is being developed as part of the project entitled "The advanced simulator demonstrator for railway vehicle operators for increasing the efficiency, effectiveness and safety of their operation" by the consortium of Qumak, IK, the Military University of Technology and the Center for Lifelong Learning in Communication Engineering (IKKU Sp. z o.o.).

The demonstrator of the simulator for railway vehicle operators

The project consists of three stages. First of all, technical, formal, and functional documentation has been developed, which will serve as training material for both experienced train drivers as well as future ones. It allows the adaptation of the simulator to the legal requirements that must be met by such equipment. Nevertheless, the achieved results enable the efficient and effective creation of the virtual reality, together with the railway infrastructure and chosen vehicles - the most significant elements of the simulation system.

Intensive design work on the simulation platform is underway. A particular focus has been placed on communication, hardware drivers and their integration.

At this stage the parameters and method of construction of, i.a. the large motion platform (6 degrees of freedom), the control panel and the audio-video system were selected. Implementation work has also commenced involving the development of hardware drivers and their integration within a single device. Initial integration of the elements and verification of their interoperability will be further implemented.

The demonstrator of the simulator for railway vehicle operators

The project is co-financed as part of the "Demonstrator" competition organized by the National Research and Development Center NCBR. The simulator will be designed for training train drivers and improving their professional skills.

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Seminars of IK (Railway Research Institute)

IK undertakes a lot of activities aimed at training personnel specializing in rail transport. They consist of post-graduate studies in cooperation with universities of technology, courses, refresher training and free technological seminars, as well as national and international conferences. Below, you will find a list of seminars that will be held in 2015. All meetings are held at the IK conference building at ul. Chłopickiego 50 in Warsaw, Poland. More information about the seminars is available at www.ikolej.pl. We encourage you to take part in them !

Mirosław Siergiejczyk
IK Scientific Secretary

Seminars of IK

January 20th, 2015	**Michał Głowacz, MSc., Eng.**	The interaction between the pantograph and the overhead line at high speeds
March 3rd, 2015	**Artur Dłużniewski, MSc., Eng.**	Electric and electromagnetic compatibility of self-propelled railway vehicles in light of the existing standards and future standard requirements
April 7th, 2015	**Marceli Lalik, MSc., Eng.** **Andrzej Zbieć, MSc., Eng.**	Loc&Pas TSI and PRM TSI requirements - update as at 2015 - in the design of modern railway vehicles
May 5th, 2015	**Konrad Zakrzewski, MSc., Eng.**	Risk analysis and assessment in light of Regulation (EC) 402-/2013
June 2nd, 2015	**Piotr Tokaj, MSc., Eng.**	Results of the previous tests and the applicability of Y-type railroad ties in Poland
July 7th, 2015	**Kolykhayev I.G (DIIT)**	Opportunities to save traction power illustrated by the case of Ukrainian Railways
September 1st, 2015	**Wisław Majewski, MSc., Eng.** **Artur Rojek, PhD., Eng.** **Marek Kaniewski, MSc., Eng.**	New generation of the contact line system equipment made of aluminum alloy
October 6th, 2015	**Dariusz Kowalczyk, PhD., Eng.** **Robert Bińkowski, MSc., Eng.**	Application of the Finite Element Method to the drawing up of accident reports on rail components
November 3rd, 2015	**Ireneusz Mikłaszewicz, Eng.** **Marcin Czarnecki, MSc., Eng.**	Current rail connection methods applied to the railway lines of PKP PLK S.A. and their qualitative assessment
December 8th, 2015	**Szymon Klemba, MSc., Eng.**	The impact of railway line modernization on railway line capacity illustrated by the railway line in Łódź Province

The third training on the basics of rail transport is going to be held in 2015. The training framework comprises 8 courses:

I. Railway basic problems
II. Railtracks
III. Railway timetable and traffic
IV. Rolling stock
V. Control command and signaling, telecommunication and telematics ICT
VI. Railway planning and investments
VII. Electric power supply
VIII Certification and TSI

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