

DEPARTMENT OF CONTROL AND INFORMATION SYSTEMS

General Information

Department of Control and Information Systems (DCIS) provides education and research in the field of automation of transport and industrial processes on the process, operational and management level where, besides usual optimization criteria, the safety criteria is required. This includes topics related to reliability and security of information manipulation with advanced artificial intelligence methods. The department guarantees four accredited study programmes in the field of study Automation: the study programme Automation in Bachelor degree, study programme Process Control Engineering and Applied Telematics in Master degree and study programme Process Control Engineering in the Doctoral degree.

The research activities of DCIS are oriented in the field of information and safety-related system analysis and synthesis ranging from solution of theoretical models to practical projects of operation including implementation. DCIS is developing automated control methods by applying the latest knowledge from artificial intelligence, intelligent sensorics, robotics, computer-vision, intelligent human-machine communication, machine-learning, secure communication and so on, which also creates room for modern cloud solutions and the IoT concept.

There are many sectors of activities in which the DCIS has an exclusive position in the Slovak Republic, especially in expertise activities in the field of analysis and synthesis of railway interlocking systems. The area of reliable and safe information transmission and processing in control of selected critical processes both in safety-related systems for all kinds of transport, complex technologies and in security systems for protection of humans and property provides dynamic incentive for all the staff.

The activities of DCIS are integrated within national and international cooperation with academic and industrial domains in distinct forms – from research projects to students and experts exchange.

In 2021, the staff of the DCIS consisted of 15 pedagogical staff, 1 research fellow, 1 technician and administrative support and 8 full-time postgraduate students. The pedagogical staff consisted of 3 professors, 7 associate professors, 4 senior lecturers with PhD. degree, 1 research fellow with a PhD. degree.

Staff of the Department

Head of the Department:	Juraj Spalek (until 31.8.2021)
Vice-head of the Department:	Aleš Janota (authorised head of the department since 1.9.2021)
Secretary:	Rastislav Pirník
Study Consultant:	Peter Nagy
Technical Support	Kamila Baxová

Sections of the Department

Section of Automation and Signalling Systems

Head of the Section:	Karol Rástočný
Professors:	Aleš Janota, Karol Rástočný, Juraj Spalek (until 8.8.2021)
Associate Professors:	Michal Gregor, Jozef Hrbček, Vojtech Šimák, Juraj Ždánky
Senior Lecturers (with PhD):	Peter Nagy

Section of Communication and Information Systems

Head of the Section:	Rastislav Pirník
Associate Professors:	Marián Hruboš, Peter Peniak, Rastislav Pirník, Peter Vestenický,
Research Fellows:	Dušan Nemec
Senior Lecturers (with PhD):	Emília Bubeníková, Peter Holečko, Alžbeta Kanáliková

Postgraduate Students

Internal (full-time):	Milan Medvedík, Roman Michalík (until 31.8.2021), Michal Mihálik, Ján Anđel, Marek Bujňák, Branislav Malobický (since 1.9.2021), Pavol Kuchár (since 1.9.2021), Michal Skuba (since 1.9.2021)
-----------------------	---

Education

Courses in Bachelor, Master and Doctoral Degree Programmes

Bachelor Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3B0102	Algorithmisation and programming	1	2 - 2 - 0
3B1100	Professional praxis	1	0 - 0 - 0
3B0203	Programming in C++	2	2 - 2 - 0
3B1200	Professional praxis	2	0 - 0 - 0
3B0304	Theory of information and signals	3	3 - 2 - 1
3B1301	Information and communication networks	3	0 - 0 - 0
3B1400	Theory of automated control	4	3 - 1 - 1
3B1401	Logical systems	4	2 - 1 - 1
3B1402	Distributed control systems	4	3 - 1 - 1
3B1403	Sensor technology	4	3 - 0 - 1
3B0401	Computer technical environment	4	1 - 0 - 1
3B1404	Professional praxis	4	0 - 0 - 0
3B1504	Bachelor project 1 A	5	0 - 0 - 5
3B1503	Communication security	5	3 - 1 - 1
3B1501	Single-chip controllers programming	5	2 - 0 - 2
3B7403	Sensor technology	5	3 - 1 - 1
3B1502	Reliability and safety of control systems	5	3 - 2 - 0
3B1500	Control Systems	5	2 - 1 - 2
3B1505	Professional praxis	5	0 - 0 - 0
3B1606	Professional praxis	6	0 - 0 - 0
3B1602	Information systems in process control	6	4 - 0 - 4
3B1600	Actuators and their control	6	5 - 2 - 2
3B1601	Control systems programming	6	2 - 0 - 2

3B1604	State exam subject	6	0 - 4 - 0
3B1605	Bachelor thesis and its presentation	6	4 - 4 - 0
3B1603	Bachelor project 2 A	6	0 - 0 - 10

*(L) lectures - (E) exercises - (Ls) labs

Master Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3I0101	Advanced methods of automated control	1	3 - 1 - 1
3I0102	Communication networks	1	3 - 1 - 1
3I0103	Signal processing theory in process control	1	2 - 1 - 1
3I1100	Telematic systems modelling	1	3 - 1 - 1
3I7100	Control systems with Safety PLC	1	2 - 0 - 2
3I0104	Interlocking and signalling systems components	1	3 - 0 - 2
3I0115	Information systems security	1	3 - 0 - 2
3I1101	Professional praxis (60 hours)	1	0 - 0 - 0
3I7101	Professional praxis (60 hours)	1	0 - 0 - 0
3I0200	Application of information systems in process control	2	2 - 0 - 2
3I0201	Secure system communication	2	3 - 1 - 1
3I0202	Control systems safety analysis	2	3 - 2 - 0
3I0203	Artificial intelligence 1	2	2 - 0 - 2
3I0204	Higher programming languages applications	2	2 - 0 - 2
3I0205	Interlocking systems	2	3 - 1 - 1
3I1200	Professional praxis	2	0 - 0 - 0
3I7200	Professional praxis	2	0 - 0 - 0
3I0300	Artificial intelligence 2	3	3 - 0 - 2
3I0301	Visualisation of processes	3	2 - 0 - 2
3I0318	Object-oriented system development	3	2 - 0 - 2
3I1300	Transport processes control	3	3 - 1 - 1
3I1301	Applied telematics diploma project 1	3	0 - 0 - 5
3I7300	Process control diploma project 1	3	0 - 0 - 5
3I0302	Interlocking systems applications	3	2 - 0 - 2
3I0303	Information systems security	3	3 - 0 - 2
3I1303	Professional praxis	3	0 - 0 - 0
3I7301	Professional praxis	3	0 - 0 - 0
3I0401	Automated identification	4	2 - 1 - 1
3I0402	Safety systems	4	2 - 0 - 2
3I1402	Elaboration and presentation of diploma thesis	4	0 - 10 - 0
3I1403	State exam subject	4	0 - 2 - 0
3I7400	Process control diploma project 2	4	0 - 0 - 5
3I7401	Elaboration and presentation of diploma thesis	4	0 - 10 - 0
3I1401	Applied telematics diploma project 2	4	0 - 0 - 5
3I7402	State exam subject	4	0 - 2 - 0
3I0400	Robotic systems	4	2 - 0 - 2

3I1400	Telematic applications	4	4 - 2 - 2
3I7403	Intelligent transportation systems	4	6 - 4 - 0
3I1404	Professional praxis	4	0 - 0 - 0
3I7404	Professional praxis	4	0 - 0 - 0

*(L) lectures - (E) exercises - (Ls) labs

Doctoral Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3D3100	World language	2	2 - 0 - 0
3D3101	Secure system communication	1	2 - 0 - 0
3D3102	Logical and event systems	1	2 - 0 - 0
3D3104	Process control	1	2 - 0 - 0
3D3105	Control systems	1	2 - 0 - 0
3D3109	Selected chapters from mathematics	1	2 - 0 - 0
3D3103	Modelling and simulation of control systems	2	2 - 0 - 0
3D3106	Reliability and safety of control systems	2	2 - 0 - 0
3D3107	Theory of automated control	2	2 - 0 - 0
3D3108	Signal processing theory in process control	2	2 - 0 - 0
3D3110	Written exam for dissertation exam and defence	3	0 - 0 - 0
3D3111	Dissertation thesis and dissertation thesis defence	6	0 - 0 - 0

*(L) lectures - (E) exercises - (Ls) labs

Research & Development

The scientific-research and development activities of department are focused on the area of control tasks algorithmisation, automation of control on process, operational and management levels, while utilising modern artificial intelligence approaches, and on the area of reliable, safe and secure communication and information processing in control of selected critical processes, above all the ones which imply the criterion of safety besides usual optimisation criteria. For reasons given there is a large number of research projects and cooperation projects with praxis and industry directed into the area of applied telematics and intelligent control and safety systems in transport and industry.

Laboratory of SIEMENS industrial processes control systems

The laboratory is oriented on development and simulation of algorithms for industrial processes control. The fundamentals of equipment are PCs, Siemens PLCs, extension modules for sensors and actuators connection, modules for remote inputs and outputs, visualisation panels, frequency converters and programming and configuration software. The interconnection of components and positions is realised by industrial networks. Actual models of industrial processes support the operation of this technology.

Laboratory of railway transport processes control

The laboratory focuses on development of safety related control systems mainly utilised for railway traffic control. The fundamentals of technology equipment are PCs and Siemens PLCs with software support. The laboratory provides real interlocking systems by Scheidt&Bachmann (BUES2000 electronic railway crossing devices and ZBS2000 electronic safe traffic control for auxiliary tracks) and by Betamont (ESB1 electronic station interlocking device). The devices also include railway interlocking devices building components (distinct relay constructions used in interlocking technology, signalling lights, switching locks, ...).

Laboratory of B&R industrial processes control systems

The laboratory is focused on the area of system identification, design and implementation of control algorithms for traffic and industrial systems. It is equipped with programmable logical automata by Bernecker + Rainer (B&R), safety PLCs, I/O modules, converters, traffic and industrial systems models, CNC multifunctional machine and it's digital twin. Specialised computers and software include Automation Studio, Safe Designer, Scene Viewer, MATLAB, Simulink, Atmel Studio.

Laboratory of microcomputers and robotics

The laboratory is intended for research and development in the area of robotics and microcomputers. It is equipped with computers and programmable interfaces for ATMEL microcomputers and ABB industrial robots. It is an exact copy of a real software controlling a production robot and enables realistic simulations with the use of real robotic programs and configuration files. The laboratory hosts the research of mobile sensor platform for robots navigation. The laboratory disposes of a CNC machine with B&R control system for the realization of bachelor and diploma works. The equipment also consists of E-puck robots with Webots environment enabling testing of robotic swarm algorithms. The equipment includes a collaborative robot ABB IRB 14000, DC and AC electric motors and Mitsubishi frequency converters.

Laboratory of automated control and signal processing

The laboratory is aimed on testing of theoretical fundamentals from the area of automated control theory (continuous and discrete systems), theory of information and signals and digital signal processing with custom programs and MATLAB with its specialised toolboxes (Simulink, Control Toolbox, Signal Processing Toolbox). It includes actual educational models by Humusoft CE 151 (ball on plane) with accessories (Extended Real Time Toolbox and Real Time Windows Target). The equipment includes a model of industrial line as a result of KEGA project equipped with B&R PLC, communication and I/O modules, inverters and traction modules. It incorporates automated identification systems based on several object identification technologies (vision systems by SICK and B&R), object identification systems based on RFID, QR and EAN codes, color scanning, induction and IR scanning by SICK.

Laboratory of modelling and simulation

The laboratory is aimed on education of specialised subjects requiring support of software tools. It is mainly intended for modelling of functional properties of control systems (UML; Rhapsody software tool), reliability and safety attributes (CARE software tool), control procedures and control structures (Matlab and LabView environments). In case of need, it is available for other applications – design and work with database systems, expert systems and so on. The laboratory includes technology utilised in objects protection (alarm systems, electric fire signalisation, camera surveillance systems). The laboratory can also be utilised for students' individual work during working out the semester projects and diploma theses.

Laboratory of computer networks and secure communications

The laboratory is focused on the area of LANs including wireless communication technologies. The technical equipment for computer networks includes basic PCs, structural cabling distributor, switches and routers 3com, Linksys and Cisco, IEEE 802.11 wireless networks analyser. The technical equipment for industrial communication networks includes PROFIBUS and CAN protocol analysers. The area of radio-frequency identification (RFID) is covered by the ELATEC demonstration kits for ISO 14443, ISO 15693, ISO 18092, MIFARE Classic, MIFARE Desfire, Unique, EPC Global transponders.

Integrated laboratory of IBM and Betamont

The laboratory aims on experimental works of PhD. students and final degree students of bachelor and master programmes. The focus is the area of development, customisation and realisation of experimental communication subsystem of Intelligent Transportation Systems (ITS). The development heads towards display appliances in the function of dynamic traffic signs, information panels and similar, primarily in the direction ITS infrastructure – driver. The development in laboratory also includes applications of distinct communication standards, primarily intended for the communication between vehicles, vehicles and infrastructure and between ITS infrastructure objects.

The laboratory is built within the following projects: „Centre of excellence for intelligent transportation systems and services I“, „Centre of excellence for intelligent transportation systems and services II“ and „New methods for measuring dynamic properties of motor vehicle and its interaction with roadway“ (in cooperation with BETAMONT), which have been acquired in the operational programme Research and development by the EU Structural funds agency of Slovak Department of Education.

Laboratory of IoT technologies

The laboratory is built within the cooperation between DCIS and IBM a is focusing on the area of intelligent transport, intelligent cities and Internet of Things (IoT) from the sensors level through data acquisition, analysis, presentation, including security aspects. The technologies available include IBM (Intelligent Operation Center, Bluemix cloud, Big Data, analytical and prediction tools), sensor networks technologies (Libelium) and information systems security devices and software (Pwnie Plug R4 penetration testing tool).

Laboratory of information technologies

The laboratory is oriented on information systems (databases, web technologies, virtualisation), computer networks (modelling, simulation, monitoring) and its safety (penetration testing, intrusion detection, firewalls, cryptanalysis, antimalware). The hardware equipment consists of Juniper IDP 75 – intrusion detection system; Fluke Networks Time Machine Express NTM - EX2 – network traffic monitoring device; wireless technologies. The software equipment consists of Riverbed Modeler + Wireless Suite – network modelling, simulation and emulation environment; Riverbed Modeler Academic Edition – academic edition of environment; PRTG Paessler Network Monitor – network traffic monitoring tool, Pwnie Plug R4 – network penetration testing appliance.

Projects of International Programmes

HORIZON 2020

H2020-MSCA-RISE-2016 - 734331: SENSors and Intelligence in Built Environment	
Summary:	The goal of this project is to develop novel information sensing research and innovation approaches for acquiring, communicating and processing a large volume of heterogeneous datasets in the context of smart buildings, by building an international, inter-disciplinary and inter-sectoral collaboration network through research and innovation staff exchanges and seamless exchange of ideas, expertise, data, testbeds, and know-how.
Realization:	01/2017 – 12/2021
Coordinator:	Ivan Glesk, (University of Strathclyde, Glasgow, UK)
Sub-Coordinator from FEE:	Juraj Machaj
Co-operators:	Peter Holečko, Michal Gregor, Vojtech Šimák

COST Projects

CA17124: Digital forensics: evidence analysis via intelligent systems and practices	
Summary:	The objective of the COST action is to form a network for the exploration of artificial intelligence and automated reasoning applications in the field of digital forensics and creating a synergy between these areas.
Realization:	09/2018 – 09/2022
Coordinator:	prof. Jesus Medina (Facultad de Ciencias, Campus Río San Pedro, Spain)
Co-operators:	Peter Holečko

Projects of National Programmes

Research Projects Funded by the Scientific Grant Agency of the Slovak Republic (VEGA)

1/0626/19: Research of localization of mobile objects in IoT environment	
Summary:	With the development of IoT networks, the number of location services is also growing, and these services have different requirements for the quality of location systems. The providers strive to provide these services regardless of the environment in which the user is located. The requirements for localization systems can be met using available technologies, but it is also necessary to take into account the efficiency of the system. Not all services require high accuracy. The aim of the project is to design a solution for a location system for the Internet of Things (IoT), which will integrate available data for the location of mobile devices and users. Potential sources of this data include wireless communication systems and sensors integrated in devices connected to the IoT. The project will focus on the research of localization algorithms based on the fingerprinting method, but also on ad-hoc networks using data from available sensors. The proposed localization system will enable the optimal use of data for localization while meeting the requirements for quality of service.
Realization:	01/2019 – 12/2021

Coordinator:	Peter Brída
Co-operators:	Peter Vestenický

Projects Funded by the Cultural & Education Grant Agency (KEGA)

014ŽU-4/2018: Broadening the content in a field of study with respect to the current requirements of the industry as regards artificial intelligence methods and IT	
Summary:	The objective of the project is to facilitate implementation of high-quality education in these areas – i.e. in the area of AI, ML and IT – with regard to the actual requirements of the industry. The second goal is to promote the transfer of progressive and innovative methods into industrial practice. The project reflects a feedback from the commercial sector (primarily within the Ready for Continental initiative and from other department industrial partners) and the feedback from international academic partners such as University of Patras, Greece; UC Berkeley, California, USA; Tongji University, Shanghai and others. The output of the project include new study materials, proper HW/SW education support and a catalogue of AI tasks and methods.
Realization:	01/2018 – 3/2021
Coordinator:	Aleš Janota
Co-operators:	Michal Gregor, (vice-coordinator), Juraj Spalek, Alžbeta Kanáliková, Emília Bubeníková, Vojtech Šimák, Jozef Hrbček, Marián Hruboš, Rastislav Pirník, Roman Michalík, Kamila Kršíková

008ŽU-4/2021: Integrated teaching for artificial intelligence methods at the University of Žilina	
Summary:	In the last few years a significant acceleration of progress in the sphere of artificial intelligence and machine learning has taken place. We have been witness to several ground-breaking discoveries, which have considerably increased the overall interest in the area. Artificial intelligence and machine learning methods can no longer be considered a thing of the distant future – quite on the contrary, many of them are already commonly applied in practice and bring immense added value. In consequence of this, companies in Slovakia have recently started to integrate such methods into their processes, services and products – however, they labour at a serious competitive disadvantage in that there has been a long-term shortage of highly qualified alumni in technical fields of study in general and programmes focused on artificial intelligence and machine learning in particular. The main goal of the proposed project is to create a common integrated initiative in education for artificial intelligence and machine learning, which would be open to the wider community and which would ensure efficient common use of educational and research capacities so as to achieve the maximum final benefit.
Realization:	04/2021 – 12/2023
Coordinator:	Michal Gregor
Co-operators:	DCIS: Aleš Janota, Dušan Nemeč, Alžbeta Kanáliková, Michal Skuba, Branislav Malobický

016ŽU-4/2018: Modernization of teaching methods of industrial processes control based on the concept of Industry 4.0	
Summary:	The project is primarily focusing on the modernisation of education in the field of automation a process control with the use of the Industry 4.0 concept. A workplace will be created integrating the latest object identification technologies used in industrial praxis and object scanning technologies based not only on classic sensors, but also on image information. Using object identification and by providing the data to cloud, it will be possible to evaluate the data from distinct aspects.
Realization:	01/2018 – 3/2021
Coordinator:	Emília Bubeníková
Co-operators:	Karol Rástočný, Aleš Janota, Juraj Spalek, Peter Holečko, Alžbeta Kanáliková, Rastislav Pirník, Dušan Nemeč, Milan Medvedík

038ŽU-4/2017: Laboratory education methods of automatic identification and localization using radiofrequency identification technology	
Summary:	<p>Automatic identification systems currently represent an irreplaceable role in the automation of industrial production, transport, logistics and trade. Among the technical means allowing automatic identification of persons, objects or animals a radio frequency identification (RFID) dominates. Taking the importance of this technology into account it is necessary that graduates of the study field "Automation" and "Telecommunication and Radio Communication Engineering" that are accredited on the Faculty of Electrical Engineering, University of Žilina, have gained deep knowledge of the principles and applications of this modern technology.</p> <p>The presented project sets a number of scientific and pedagogical objectives. In the scientific objectives the mathematical modelling of RFID systems and their data channels, and also the development of digital signal processing algorithms in the field of RFID are dominant. The dominant educational objectives are the building of several laboratory workplaces enabling to demonstrate the basic physical principles of identification and localization of the RFID tags and to demonstrate the data structures of most commonly used identification cards such as Mifare and Desfire.</p>
Realization:	01/2017 – 12/2019
Coordinator:	Peter Vestenický
Co-operators:	Martin Vestenický, (KMaIKT) until 13. 3. 2019, Michal Gregor, Peter Nagy, Dušan Nemeč, Juraj Žďánsky, Michal Kuba, (KMaIKT), Jozef Valigurský

008ŽU-4/2019: Modernization and expansion of educational possibilities in the field of safe controlling of industrial processes using the safety PLC	
Summary:	The project is focused on building and modernizing of the laboratory allowing the safe industrial process control using the safety PLC. The laboratory was successfully built within the previous KEGAprject. It includes six full-featured workplaces with safety PLC and physical models allowing the simulation of real situations from industry. The aim of the present project is to extend this laboratory to enable the realization of the complex distributed control systems with safety PLC and safe control of actuators. This will allow the extension of the related subject "Control Systems with Safety PLC" and the subsequent solution of bachelor, diploma and dissertation works, as well as the realization of workshops, the creation of teaching materials and sample examples. Due to the great interest of practice in this area,

	the aim of the project is to maintain and develop well-functioning co-operation with practice, particularly in the field of consultation on achieving the required safety integrity level (SIL) of realized applications.
Realization:	01/2019 – 12/2021
Coordinator:	Juraj Ždánsky
Co-operators:	Karol Rástočný, (vice-coordinator), Jozef Hrbček, Peter Nagy, Vojtech Šimák, Milan Medvedík, Jozef Valigurský (until 8.6.2020)

Research Projects Funded by the Slovak Research and Development Agency (APVV)

APVV-17-0014: Smart tunnel: telematic support for emergencies in the traffic tunnel	
Summary:	The objective of the project is to design of a unique and competitive system, which will enable to decrease safety risks resulting from the operation of a road tunnel. The system design and functional specification will be provided in a proper form for realisation of commercial solutions. The consumer will be provided by an integrated UML software specification with focus on identification and classification of safety critical events in tunnels.
Realization:	07/2018 – 12/2021
Coordinator:	Rastislav Pirník
Vice-coordinator	Jozef Svetlík
Co-operators:	Emília Bubeníková, Marián Hruboš, Peter Holečko, Aleš Janota, Peter Nagy, Juraj Spalek (until 08/2021), Dušan Nemeč, Kamila Kršíková, Marek Bujnák

APVV-20-0626 HuDyM - Biofidelic human body surrogate to increase the objectivity within the forensic analysis of road traffic accidents.	
Summary:	Forensic analysis of road traffic accidents (TA) within the expert department "03 03 01 Road traffic accidents" is complex and interdisciplinary problematics with potentially extensive volume of input parameters within the axis "vehicle-human-road". Input parameters are often of partial character and with technical uncertainties. This has a negative influence with respect to unambiguity of technical reconstruction and analysis of TA, that serves as a basis for decision making in criminal justice system. Within the forensic analysis of TA with vulnerable road users (pedestrians, cyclists), influence of the element "human" is significant for reconstruction and analysis of this subset of TA. This is valid particularly regarding using the human body injuries as a basis for determining the course of TA. Suggested research deals with current problematics of virtual and real-world surrogates of human body that will serve primarily for interdisciplinary objective forensic analysis of TA with vulnerable road users, but with application in other fields that use knowledge of injury biomechanics. Mathematical-physical models and real-world surrogates of human body that currently exist do not provide level of commonly available and universally applicable tools for wide spectrum of applications. This argument is valid in international context. The goal of suggested project is integrated research and construction of simulation mathematical-physical model and real-world surrogate of adult human body with increased biomechanical fidelity for multidirectional mechanical loading with focus on dynamic impact loading of vulnerable road users within TA. Project outputs will be applied directly in traffic accident analysis, but also in analysis of human body movement in forensic

	reconstruction of criminal cases, analysis of other accident events (work injury) and biomechanical research of injury mechanisms in human body dynamic loading.
Realization:	07/2021 – 12/2024
Coordinator:	Eduard Kolla (UZVV)
Co-operators:	Peter Vestenický

Projects of European Structural Funds

ITMS 313011B765: Universal virtual intelligent space for transport systems	
Summary:	The research objective is in creating a system environment of information sources based on IoE, its advanced processing, connection to other life areas, searching for correlations between things, processes (information), seemingly unrelated, using these discovered dependencies in technological innovations, decision making and process control in transport and in standard living of citizens.
Realization:	09/2017 – 08/2022
Coordinator (UNIZA):	Rastislav Pirník
Project manager (UNIZA)	Rastislav Pirník
Co-operators:	Aleš Janota, Juraj Spalek, Mária Franeková, Pavel Příbyl, Peter Vestenický, Marian Hruboš, Peter Holečko, Emília Bubeníková, Vojtech Šimák, Jozef Hrbček, Michal Gregor, Alžbeta Kanáliková, Dušan Nemec

Other National Non-research Projects

002ZU-2-1-2021: Hybrid education in artificial intelligence, machine learning and cybernetics at the UNIZA	
Summary:	The project will provide courses in English that will provide participants with the necessary theoretical knowledge and practical skills in the field of artificial intelligence (AI), machine learning (ML) and cybernetics. The courses will be divided into three levels of difficulty: (i) basic, user-oriented, (ii) advanced, incorporating deeper theoretical knowledge and the ability to combine, more complexly parameterize and apply methods more effectively; (iii) expert, providing a detailed understanding, at the level required e.g. for research in the field. The courses will combine full-time and part-time, so that participants will be able to enter them as needed and proceed at their own pace. The modular nature of the courses will allow them to focus on areas that are a priority in terms of their needs. The educational content will focus on modern methods with high potential: they will be identified on the basis of recommendations from excellent workplaces (eg feedback from UC Berkeley), practical requirements and analysis of quantitative indicators. The courses will enable continuous training of researchers, students and practitioners who will apply or develop AI and ML methods in their activities. They will enable them to acquire the knowledge and skills necessary for the effective use of methods, but also for the correct evaluation and interpretation of their results, and thus significantly streamline the transfer of the most current knowledge into practice. Due to the great diversity of participants, the preparation of the content will pay special attention to the pedagogical adequacy and quality of the content as well as the lecturer's own, which guarantees the involvement of experts in the field of lifelong learning. The resulting pilot project will be able to be expanded in the future to include other universities, which will also help reduce unwanted fragmentation,

	support the networking and coordination of national educational and research activities in the field of AI and ML, and help make the Slovak academic area more attractive as a whole.
Realization:	12/2020 – 12/2022
Coordinator:	Róbert Hudec
Co-operators:	DCIS: Michal Gregor, Aleš Janota, Dušan Nemec, Jozef Hrbček, Vojtech Šimák

UNIZA Grant Projects

7987: Autonomous e-tricycle	
Summary:	The project is focused on the design and creation of an autonomous tricycle, whose primary task will be to map the space in which it is located. Based on the generated environment map, the tricycle will be able to move autonomously.
Realization:	09/2020 – 08/2021
Coordinator:	Michal Mihálik
Project leader:	Marián Hruboš

7988: Control of the position of a loose ball on a vertically positioned disc by means of a PLC	
Summary:	The essence of the project is to create a teaching model that will implement the control of the position of a loose ball on a vertically positioned disc. The constructed model will serve as a preparation for teaching and also as a scientific-popularization tool for the presentation of studies at our university for those interested in studying.
Realization:	09/2020 – 08/2021
Coordinator:	Milan Medvedík
Project leader:	Juraj Ždánsky

7991: Parallel robot controlled by PLC and its digital copy	
Summary:	The project is focused on the design and creation of a parallel robot based on a model that can be connected to the control system in simulation. This procedure will accelerate the development of the application implementation with the possibility of creating a control program for the PLC and tuning the system in the design phase. The created robot and its digital copy will be used for presentation activities and as a teaching aid without the need for real equipment.
Realization:	09/2020 – 08/2021
Coordinator:	Roman Michalík
Project leader:	Jozef Hrbček

14873: Safety features in the force testing process	
Summary:	The project is focused on the design and creation of an arm designed to measure a person's physical condition. The system will include security functions to ensure the safety of persons. The design and implementation will be based on a model that can be connected to the control system in simulation. This procedure will accelerate the development of the application implementation with the possibility of creating a control program for the PLC and tuning the system already in the design phase. The created system will be used for presentation activities and also as a teaching aid.
Realization:	09/2021 – 08/2022
Coordinator:	Marián Hruboš

Project leader:	Jozef Hrbček
-----------------	--------------

12757: Spherical robot to support the resolution of emergencies in tunnel construction.	
Summary:	This project is focused on the design of a spherical robot that will move in a dangerous environment of a road tunnel during an accident. During its deployment, the environment will be scanned and the concentration and temperature of the gases will be measured.
Realization:	09/2021 – 08/2022
Coordinator:	Marek Bujňák
Project leader:	Rastislav Pirník

8017: Robotic system for mapping safety-critical areas	
Summary:	The main goal is to combine the hardware and software part in order to work with the data as efficiently as possible when creating a map and navigating in space. Another goal that will need to be met is for the system to work with the least possible response time.
Realization:	09/2020 – 08/2021
Coordinator:	Marián Hruboš

Submitted Proposals of International Research Projects in 2021

Type / call	Project title	Outcome of evaluation
Visegrad Fund	<p>Use of Modern Simulation Tools in Logistics and Transport in context HMI in V4 Countries (SiToLaT)</p> <p>Project partners: main partner on behalf on Czech University of Technology in Prague with the support of University of Defence BRNO, coordinator: Tomáš Tichý and Martin Vlkovský</p> <p>SR partner: University of Žilina, Task: current status of use of simulators, virtual reality, possible applications in public sector, pros-cons of these technologies in Slovakia, coordinator for SR: Rastislav Pirník.</p> <p>HU partner: UNIVERSITY OF PUBLIC SERVICE LUDOVIKA, Task: use of simulation tools in public sector in Hungary, pros-cons of these technologies,</p> <p>PL partner: Krakow University of Technology, Task: use of simulation tools in public sector in Poland, mathematical methods, pros-cons of these technologies.</p>	not supported

Outputs from Solved Research Tasks

Publication activities at the FEEIT in 2021 (based on registration at the University Library up to February 2022)

Kategória	Názov kategórie (podľa UK) <i>Túto sumárnu tabuľku nevyplňat', pripraví dekanát za celú FEIT podľa evidencie v Univerzitetnej knižnici. Ostatné nasledujúce tabuľky – monografie, ..., vyplňat'</i>	Počet
AAA		
AAB		
ACA		
ACB		
ADC		
ADD		
ADE		
ADF		
ADM		
ADN		
AEC		
AED		
ADE		
ADF		
AGJ		
BCI		
...		

Current Content Journals

[1]	KUCHÁR, Pavol – PIRNÍK, Rastislav – TICHÝ, Tomáš – RÁSTOČNÝ, Karol - SKUBA, Michal – TETTAMANTI, Tomás.: Noninvasive Passenger Detection Comparison Using Thermal Imager and IP Cameras. In: Sustainability, Vol.13, No. 22, ISSN 2071-1050, p. 1-17.
[2]	TICHÝ, Tomáš – BROŽ, Jiří – BĚLINOVÁ, Zuzana – PIRNÍK, Rastislav: Analysis of predictive maintenance for tunnel systems. In: Sustainability, Vol: 13, Issue: 7, ISSN 2071-1050, p. 1-17.
[3]	NEMEC, Dušan – HRUBOŠ, Marián – JANOTA, Aleš – PIRNÍK, Rastislav – GREGOR, Michal: Estimation of the speed from the odometer readings using optimized curve-fitting filter. In: IEEE Sensors Journal: a Publication of the IEEE Sensors Council, Vol. 21, No. 14, ISSN 1530-437X, p. 15687-15695.
[4]	MICHALÍK, Roman – JANOTA, Aleš – GREGOR, Michal – HRUBOŠ, Marián: Human-Robot Motion Control Application with Artificial Intelligence for a Cooperating YuMi Robot. In: Electronics 2021, Vol. 10, No. 16, ISSN 2079-9292, p. 1-13.
[5]	HRUBOŠ, Marián – NEMEC, Dušan – BUBENÍKOVÁ, Emília – HOLEČKO, Peter – SPALEK, Juraj – MIHÁLIK, Michal – BUJŇÁK, Marek – ANDEL, Ján – TICHÝ, Tomáš: Model-Based Predictive Detector of a Fire inside the Road Tunnel for Intelligent Vehicles. In: Journal of Advanced Transportation, ISSN 0197-6729, p. 1-14.

Patents, Industrial Designs, Author's Certificates and Discoveries

Submitted in 2021:

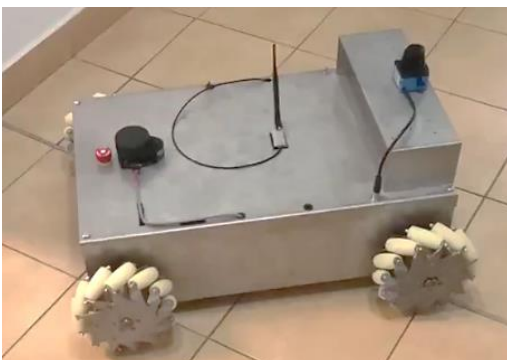
[1]	Category: industrial design Application number: PUV 180-2020 Date of application publication: 27.01.2021 Date of public availability: 03.05.2021
-----	---

	Authors: Hruboš Marián, Pirník Rastislav, Dušan Nemeč, Gregor Michal, Bujňák Marek Title: Equipment for measuring critical environmental parameters Granted by: Industrial Property Office of the Slovak Republic
[2]	Category: industrial design Application number: PUV 229-2020 Date of application publication: 14.04.2021 Date of public availability: 29.07.2021 Authors: Hruboš Marián, Dušan Nemeč, Pirník Rastislav, Janota Aleš, Tichý Tomáš, Bubeníková Emília Title: Emergency telematics support equipment Granted by: Industrial Property Office of the Slovak Republic
[3]	Category: industrial design Application number: 119-2020 Date of application publication: 03.11.2020 Date of public availability: 12.02.2021 Authors: Gregor Michal, Hruboš Marián, Janota Aleš, Nemeč Dušan Title: Intelligent audiovisual interface of a flexible robot Granted by: Industrial Property Office of the Slovak Republic

Specific Realization Outputs

Output type: Implementation of a robot prototype and robot control software, including safety communication protocol in the project APVV 0017-0014 Smart tunnel: telematics support in case of extraordinary events in the traffic tunnel

Output description: Proposed approaches within no. 5.: SAFETY AND SECURITY sensor platform were implemented and verified in a built 4-wheeled mobile robot. The main controller is based on the Arduino Due board (with a single-core ARM Cortex-M3 SAM3X8E with a frequency of 84 MHz), as it provides 5 independent UART connections. The touchless controller is implemented on the basis of the ESP-32 module connected to 2 LIDARs (the front is the Sick TIM510 and the rear is the RPLIDAR-A1M8). The decision driver is based on the NVIDIA Jetson Nano board. The robot is driven by 4 Gyems RMD X8-PRO servomotors communicating via the RS485 bus with the main controller. Each engine is capable of providing 35 Nm or 13 Nm of torque at a nominal speed of 155 rpm. The robot is powered by a 12-cell LiFePO4 105Ah battery with BMS. The robot can be equipped with 204 mm Meccanum wheels or 330 mm wheels from a tractor for outdoor use. The maximum speed with the tractor wheels is approx. 15 km.h-1 and the operating weight of the robot is approx. 70 kg with a maximum payload of 100 kg.



Co-operation

Co-operation Partners in Slovakia

- ABB, s.r.o. Banská Bystrica
- Aliga, s.r.o. Martin
- AŽD Slovakia, Bratislava
- B+R automatizace, s.r.o. Nové Mesto nad Váhom
- Betamont, s.r.o. Zvolen
- Continental Matador Rubber, s.r.o., Púchov-Horné Kočkovce
- Department of cybernetics and artificial intelligence, FEI TU Košice
- ELTODO SK, s.r.o. Bratislava
- FMach, s.r.o., Žilina
- Global Logic, Žilina
- HMM s.r.o., Bratislava
- IBM Slovensko, Bratislava
- Institute of robotics and cybernetics, FEI STU Bratislava
- KUMAT spol. s r. o., Bratislava
- MTS Krivá
- National highway company, Bratislava
- PPA INŽINIERING, s.r.o., Bratislava
- Profibus SK association
- Scheidt & Bachmann Slovensko s. r. o., Žilina
- SICK Bratislava
- Siemens s. r. o., CEE RU-SK IC-MOL RA RA-COC
- Siemens s.r.o., Digital Factory/ Factory Automation/ Automation systems (IA&DT)
- SIMAP SK, s.r.o. Trenčín
- Slovak.AI
- SOITRON, s.r.o., Bratislava
- ŽSR, Bratislava

International Co-operation Partners

- AŽD Praha s.r.o., CR
- B&R Industrial Automation GmbH, Austria
- Faculty of Technical Sciences, University of Novi Sad, Serbia
- PanonIT, Serbia
- První Signální, a.s., CR
- SIEMENS Mobility GmbH, Austria
- TeZaSig s.r.o., Czech republic
- University of Strathclyde, Glasgow, UK

Non-contractual Cooperation with Academic Institutions

- FD ČVUT Prague, Czech Republic
- FEI STU Bratislava
- FEI VŠB - TU Ostrava, Czech Republic

- FEI TUKE Košice
- Riazan State Radiotechnical University, Russia
- Laboratory for Automation and Robotics, University of Patras, Greece
- MTF STU Bratislava, detached in Trnava

Visits to Foreign Institutions

Name	Institution	Length of stay
Aleš Janota	TU Ostrava, CR	1 day
Rastislav Pirník	CVUT Faculty of Transport (Erasmus)	4 days

Contracts (Business Activities)

FEIT/XX/2020: Evaluation on safety of binding of RLC23 system on the crossing at km 39,619 on the Nitra – Lužianky to station safety device Lužianky	
Customer:	AP Signaling, s.r.o., Martin
Coordinator:	Karol Rástočný

FEIT/XX/2020: Analytical and consulting work and elaboration of independent assessments to address the technical safety of GP JAZZ	
Customer:	AŽD Praha s.r.o., Žirovnická 3146/2, Záběhlce, 106 00 Praha 10
Coordinator:	Karol Rástočný

FEIT/XX/2020: Safety assessment of PZS circuits type PZSBT - specific application for PZS Somotor at km 27,013 ŽSR	
Customer:	BETAMONT spol. s r.o., J. Jesenského 1054/44, 960 03 Zvolen
Coordinator:	Karol Rástočný

Other Activities

Conferences, Workshops, Symposiums Organized by the Department

- Webinar - TIA Portal Project Server and Tia Portal Test Suite Advanced, 28.01.2021, online, lecturers: Siemens specialists, organiser: Juraj Ždánsky

Specialised Lectures and Courses Organized by the Department

Summer machine learning school @UNIZA 2021	
Customer:	Participation open to students from any institution; held online, in English and with the participation of the University of L'Aquila and the University of Belgrade
Lecturer:	Michal Gregor, Milan Straka (FMI UNIZA)
Date:	13.09.2021 – 17.09.2021

Use of safety PLC Simatic to control a safety-critical process	
Customer:	HEITEC Slovensko, s r.o.
Lecturer:	Juraj Ždánsky

Date:	6.10.2021 – 8.10.2021
-------	-----------------------

Programming course: motor control, visualization, Digital Twin	
Customer:	Specialized online course for students of the study program Automation
Lecturer:	Jozef Hrbček
Date:	8.12.2021

Membership in International Institutions/Committees

Membership of the Department in international organizations	Membership since
Transport telematics association, CR	2007

Individual membership of employees of international organizations		Function
Aleš Janota	Association for Computing Machinery (ACM), USA	member
Aleš Janota	International Institute of Informatics and Systemics, USA	member
Aleš Janota	Polish Academy of Sciences (PAN) – Transportation Committee, Katowice, Poland	member-cooperator
Rastislav Pirník	Cooperative systems (SDT), CR	member of workgroup

Individual membership of employees in scientific committees of international journals		Function
Michal Gregor	Applied Computer Science, ISSN 2353-6977	member of scientific board
Aleš Janota	Archives of Transport System Telematics, ISSN 1899-8208, Poland	chair of scientific board
Aleš Janota	TransNav International Journal on Marine Navigation and Safety of Sea Transportation, ISSN 2083-6473, Poland	member of programme board
Aleš Janota	transEngin Journal of civil engineering and transport, ISSN 2658, e-ISSN 2658-2120, Poland	member of scientific board
Aleš Janota	Journal of Automation, Electronics and Electrical Engineering, p-ISSN 2658-2058, e-ISSN 2719-2954, Poland	member of scientific board
Karol Rástočný	Archives of Transport System Telematics, Polish Association of Transport Telematics, ISSN 1899-8208, Poland	member of editorial board
Karol Rástočný	Advances in Electrical and Electronic Engineering, ISSN 1804-3119, CR	member of editorial board
Karol Rástočný	Wspolczesne systemy transportowe, ISSN 2449-7851, Poland	member of editorial board
Karol Rástočný	Railway Reports, ISSN 0552-2145, Poland	member of editorial board
Juraj Spalek	Annals of Faculty Engineering Hunedoara – Journal of Engineering, ISSN 1584-2665, ISSN 1584-2673, indexed in Index Copernicus – Journal Master List, Romania	member of editorial board

Juraj Spalek	Acta Technica Corviniensis – Bulletin of Engineering, e-ISSN: 2067-3809, Edited by Faculty of Engineering Hunedoara University Politehnica Timisoara, Romania	member of scientific board
Juraj Spalek	Archives of Transport Systems Telematics, Polish Association of Transport Telematics, ISSN 1899-8208, Poland	member of international programme committee
Juraj Ždánsky	Archives of Transport System Telematics, Polish Association of Transport Telematics, ISSN 1899-8208, Poland	member of scientific-programme board

Individual membership of employees in the scientific committees of international conferences		Function
Aleš Janota	XXIV International Conference „Computer Systems Aided Science, Industry and Transport“ (TransComp), TST2020, Zakopané, Poľsko	member of scientific board
Aleš Janota	14th International Conference on Marine Navigation and Safety of Sea Transportation TransNav 2021, Gdynia, Poland	member of scientific programme board
Aleš Janota	IEEE 19th World Symposium on Applied Machine Intelligence and Informatics (SAMI 2021), Herľany, Slovakia	member of technical programme board
Aleš Janota	International Conference on Information and Digital Technologies 2021 (IDT 2021), Žilina, Slovakia	member of scientific programme board
Karol Rástočný	International Conference „Applied Electronics“, AE 2021	member of scientific board
Karol Rástočný	International Conference „TRANSCOM 2021“	member of scientific board
Juraj Spalek	XVI-th International Scientific and Technical Conference Computer Science and Information Technologies CSIT 2021	member of programme board
Rastislav Pirník	Konferencia ELEKTRO	member of scientific board
Emília Bubeníková	XVIII International Conference Multidisciplinary Aspects of Production Engineering MAPE 2021	member of scientific board

Individual membership of employees in scientific boards and trade committees abroad		Function
Aleš Janota	VŠB-TU Ostrava, FEI, Czech republic, branch board of the Cybernetics study programme	member
Aleš Janota	ČVUT Praha, Faculty of Transport, Czech republic, branch board of the doctoral study programme Smart Cities	member
Juraj Spalek	VŠB-TU Ostrava, HGF, CR	member of branch committee
Peter Vestenický	VŠB-TU Ostrava, HGF, CR	member of branch committee

Membership in National Institutions/Committees

Membership of the Department in organizations of the SR	Membership since
Slovak society for cybernetics and informatics at SAV (SSKI)	2000

Individual membership of employees in organizations of the SR		Function
Aleš Janota	National robotics centre, Bratislava	honorary member
Juraj Spalek	National robotics centre, Bratislava	honorary member
Rastislav Pirník	Mechatronic systems in the field of study Cybernetics 3rd degree	workgroup member
Rastislav Pirník	Council for Internal Quality Assurance System at STU - Cybernetics	board member
Michal Gregor	AI4SK	executive board member
Peter Holečko	Profibus SK association	member

Individual membership of employees in editorial boards of national journals		Function
Karol Rástočný	AT&P Journal, ISSN 1335-2237	member of editorial board
Juraj Ždánsky	AT&P Journal, ISSN 1335-2237	member of editorial board
Rastislav Pirník	Acta Technología, ISSN 2453-675X	member of editorial board

Individual membership of employees in the scientific committees of national conferences		Function
Rastislav Pirník	ARTEP conference	member of programme board

Individual membership of employees in scientific boards and trade committees outside of FEE UNIZA		Function
Emília Bubeníková	VTS association at the UNIZA	member
Aleš Janota	Branch committee of study programme 9.2.9 Applied informatics, Faculty of management and informatics, UNIZA, Žilina	member
Juraj Spalek	Branch committee of study programme 9.2.9 Applied informatics, Faculty of management and informatics, UNIZA, Žilina	member until 31.8.2021
Juraj Spalek	UNIZA	member until 31.8.2021
Juraj Spalek	UNIZA FSE	member until 31.8.2021

Contact Address

EN

Department of Control and Information Systems
Faculty of Electrical Engineering and Information Technology
University of Žilina
Univerzitná 1, 010 26 Žilina
Slovak Republic
Phone: +421-41-513 3301
Fax: +421-41-513 1515
E-mail: kris@feit.uniza.sk
www: <http://kris.uniza.sk/en>

SK

Katedra riadiacich a informačných systémov
Fakulta elektrotechniky a informačných technológií
Žilinská univerzita
Univerzitná 1, 010 26 Žilina
Slovenská republika
Telefón: +421-41-513 3301
Fax: +421-41-513 1515
E-mail: kris@feit.uniza.sk
www: <http://kris.uniza.sk/>