Institute of Control and Computation Engineering

2020 Annual Report

From the Director

The Institute of Control and Computation Engineering (ICCE; in Polish: Instytut Automatyki i Informatyki Stosowanej) was founded in 1955 as the Chair of Automatic Control and Telemechanics by Professor Władysław Findeisen. It was reorganized in 1970 to become the Institute of Automatic Control. Rapid development of microprocessor technology and its impact on the field of control in recent years directed the interest of the research staff and students towards computational and algorithmic aspects of control, decision support, man-machine interfaces, network communications etc. This resulted in 1994 in the creation of new educational profiles offered by the Institute and a change of its name to the present one.

The Institute offers courses in Automatic Control and Robotics as well as in Computer Science, both at three levels of education (undergraduate, postgraduate, Ph.D.). We are proud to offer interesting opportunities to our postgraduates, so that they can continue their study and research towards a Ph.D. It is important that our postgraduate and Ph.D. courses are open for candidates with different educational background. Our courses attract more and more candidates who graduated from various universities and with degrees in different fields, not only in Automatic Control and Robotics or in Computer Science. During the last few years we made an effort to organize and equip new laboratories located in a new part of our building. Currently, all our students benefit from new laboratories, without which it would be impossible to offer a few new courses. This standard educational offer has been supplemented by three postgraduate studies: Management of Information Technology Resources and Project Management organized by Dr. Andrzej Zalewski as well as Designing Information Systems with Databases organized by Dr. Tomasz Traczyk.

This year the Institute received a grant for a project entitled *Look and learn: Acquiring skills by a robot-companion on the basis of task demonstration*, from Warsaw University of Technology Centre for Priority Research Area *Artificial Intelligence and Robotics*, within the Excellence Initiative: Research University (IDUB) programme. The aim of the project is to develop key technologies and methods necessary to construct a companion-robot control system. It is headed by dr hab. Wojciech Szynkiewicz.

In 2020 the Institute successfully completed the reserch conducted with the framework of the following projects. The project *National cybersecurity platform (NPC)* was funded by National Centre for Research and Development. It was headed by Prof. Ewa Niewiadomska-Szynkiewicz and was coordinated by NASK-PIB, while involving also National Institute of Telecommunications and National Centre for Nuclear Research. The goal of the project was to develop a comprehensive, integrated system for continuous monitoring, detection, and warning of threats identified in a near real-time in the State's cyberspace. The group headed by prof. Andrzej Pacut concluded their work on a project *enhAnced Mobile BiomEtRics (AMBER)*, realised within the framework of Marie Skłodowska-Curie European Training Network (Horizon 2020). The partners of the project were: University of Kent (The United Kingdom) – the coordinator, Universidad Carlos III De Madrid (Spain), Otto von Guericke Universitaet Magdeburg (Germany) and WUT (Poland). The project developed solutions and theory to ensure secure, ubiquitous and efficient authentication whilst protecting privacy of citizens. The Optimization and Decision Support Group continued their work on the project entitled *Advanced methods of integrated decision support processes for planning sustainable socio-economic development*.

The team: L. Bielczynski, M. Przybysz, C. Limache, A Pacut, T. Śliwinski, I. Żółtowska obtained a US Patent US20200019978A1 for *System and method for price optimization of stay accommodation reservations using broad and dynamic analyses*.

The Scientific Council for the Discipline of Automatic Control, Electronics and Electrical Engineering of Warsaw University of Technology conferred upon Dr Piotr Marusak the habilitation degree for his work entitled *Numerically efficient predictive control algorithms based on linear and nonlinear models*. The Scientific Council for the Discipline of and Information and Communication Technology of Warsaw University of Technology conferred upon Dr Michał Karpowicz the habilitation degree for his work entitled *The development of a theoretical basis for the synthesis of selected control mechanisms for ICT systems*. Dr Andrzej Wojtulewicz was awarded a Ph.D. degree for his thesis entitled *Design of Control Systems Utilising Predictive Regulator Algorithms and FPGA Structures*. He was awarded a distinction for his work. Dr. Piotr Pałka received the Rector's Award of the 1st Class for his didactic achievements. Moreover, in October 2020 he became the Head of Rector's Team for the Innovative Forms of Education. It is my pleasure to congratulate all the above for their achievements.

Last year was marked by the pandemy caused by Covid-19 virus, what forced us into remote teaching. This not only changed significantly the way we interact with our students, but also hindered our research efforts by limiting the access to laboratories. I hereby express my appreciation to all of the staff of the Institute for their understanding and efforts to remedy this unfortunate situation.

Finally, I deeply regret to inform that the previous director of ICCE, professor Włodzimierz Ogryczak, passed away on the 15th of September 2020, two weeks before the end of his term as the director of the institute. We remember him not only as a renowned scientist but also as a cheerful person, a friend to many of us.

Cezary Zieliński

On the 15th of September 2020 professor Włodzimierz Ogryczak, the director of the Institute of Control and Computation Engineering, passed away. He was not only the director of our Institute and renowned scientist, but also our friend. Such a sad event is always an occasion to summarise the more prominent stages of career and the achievements of the deceased.

Professor Włodzimierz Ogryczak was born on the 5th of February 1951 in Warsaw. Both the M.Sc. (1973) and Ph.D. (1983) were conferred upon him by the University of Warsaw and both were in mathematics. In 1997 the habilitation degree was conferred upon him by the Systems Research Institute of the Polish Academy of Sciences. The State Title of Professor in Technical Sciences was conferred upon him by the President in 2011.

Since 2000 he has been with the Institute of Control and Computation Engineering (ICCE) at the Warsaw University of Technology. Earlier he was employed by the Institute of Informatics of the University of Warsaw (1973–2000). He also worked for foreign research institutions, e.g. Marshall University, USA (1989–1992), where he held the H.P.Kizer Eminent Scholar Chair in Computer Science; Université Libre de Bruxelles, Belgium (1994-1995), where he was as a visiting professor at the Department of Operations Research and Multicriteria Decision Aid (Service de Mathématiques de la Gestion); and Université Pierre et Marie Curie, Paris VI, France (2010), where he did his research with the Computer Science Laboratory. He also lectured at the Higher School of Economics and Informatics (Wyższa Szkoła Ekonomiczno-Informatyczna) (2002–2009). The students of Warsaw University of Technology enjoyed his lectures delivered both in Polish and English. He lectured for the EMARO and ATHENS students. Under his supervision more than 100 students were promoted. Moreover, 5 doctor degrees were conferred upon his Ph.D. students.

His research interests were focused on theoretical research, computer solutions and interdisciplinary applications in the area of optimization and decision making with the main stress on: multiple criteria optimization and decision support, decision making under risk, location and distribution problems. Initially his research interests focused on computational algorithms of linear programming, what resulted in the joint publication with K. Zorychtą of the monograph entitled "Linear and Integer Programming", Scientific-Technical Publishers (WNT), in 1981. In the years 1986–1996 he took part in the investigations coordinated by prof. A.P.Wierzbicki, conducted at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg near Wien in Austria. He designed and implemented a Dynamic Interactive Network Analysis System (DINAS) for the multiple criteria analysis of location and distribution problems. He also took part in the implementation of MOMIP, a package for the solution of integer optimisation problems. This research led to the elaboration of axiomatic conceptions and methodology for multi-criteria optimisation with homogeneous evaluation. In consequence this shifted his research interests towards decision support under risk and uncertainty. The introduction of social factors into optimisation methods and decision support led to the elaboration of fair multiple criteria optimisation. As a result together with R.Mansini and M.G.Speranzą the monograph "Linear and Mixed Integer Programming for Portfolio Optimization" was published by Springer in 2015. He published over 170 works, including 4 monographs, 3 textbooks, 85 journal papers. He was the leader in many externally funded research projects.

He actively participated in international activities. Since 1989 he was the member-founder of the International Society for Multiple Criteria Decision Making (ISMCDM), and since 1990 the member of The Institute for Operations Research and Management Science (INFORMS).

His research gained him in Poland the election as a member of the Committee of Informatics of the Polish Academy of Sciences.

In ICCE he acted as: the head of the Division of Optimisation and Decision Support (2003–2008), deputy director for research (2008–2016) and finally since 2016 its director.

Besides his research interests he was passionate about photography and tourism. He also collected old maps. A truly Renaissance person.

Spis treści

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1   General Information

The following information about organization of the Institute reflects the situation on
December 31, 2020.

1.1   Directors

Professor Włodzimierz Ogryczak , Director (until September 2020),
Professor Cezary Zieliński (since October 2020)
Professor Maciej Ławryńczuk, Deputy Director for Research
Dr. Tomasz Traczyk, Deputy Director for Academic Affairs

1.2   Organization of the Institute

Systems Control Division

Division Head:	Professor C. Zieliński (until Sept. 2020)
Professors:	W. Kasprzak, E. Niewiadomska-Szynkiewicz, A. Pacut, C. Zieliński
Professors, retired:	W. Findeisen, R. Ładziński, K. Malinowski, J. Szymanowski
Assistant Professors:	P. Arabas, M. Kamola, A. Karbowski, M. Karpowicz, T. Kornuta, A. Kozakiewicz, T.J. Kruk, W. Szynkiewicz, M. Trokielewicz, T. Winiarski, A. Wilkowski
Assistant:	D. Seredyński, M. Stefańczyk, M. Azimi, J. Nourmohammadi Khiarak, W. Dudek, M. Figat
Ph.D. Students:	Ł. Bala, E. Bartuzi, W. Dudek, M. Figat, K. Gabor-Sitkowska, W. Gutfeter, M. Hałoń, J. Karwowski, M. Krzysztoń, P. Piwowarski, D. Seredyński, P. Szelągowski, K. Roszczewska, M. Węgierek

Research of the division is conducted in 3 research groups:

Complex Systems Group (**E. Niewiadomska-Szynkiewicz**, P. Arabas, M. Kamola, A. Karbowski, M. Karpowicz, A. Kozakiewicz, T.J. Kruk, M. Krzysztoń, K. Malinowski)

The main area of interest are problems of modeling, design, control, optimization and simulation of various types of complex real systems, including networks, ad hoc networks, social networks, economic systems and the environment. Research in the field of optimization and control are focused on developing the theory and methodology in applying model predictive control, hierarchical control structures in nonlinear systems with uncertainty, developing methods for solving continuous and discrete time optimization problems (including evolutionary optimization methods and using the arithmetic of intervals), game theory and design theory of complex systems of rules (so-called theory of mechanisms). Research in the field of computer simulation and parallel processing of information concerning such departments as: distributed operating systems, programming of parallel machines in computer networks, clusters, grids and GPUs, the creation of systems for computer-aided design and management. Particular attention is devoted to issues of modeling, management and security in computer networks, including sensor networks and mobile ad hoc networks.

Biometrics and Machine Learning Group (**A. Pacut**, E. Bartuzi, W. Gutfeter, K. Roszczewska, M. Trokielewicz, K. Gabor-Siatkowska, M. Hałoń)

Research of the group is centered on biologically inspired information processing and control, including biometrics, machine learning, uncertainty modeling, and biological modeling. Biometrics consists in using personal characteristics for identity recognition. Our research is focused mainly on safety of biometrics software, systems, and applications. In particular, safety issues are investigated for iris, fingerprints, and finger veins. Safety of biometric data storage and exchange and data encryption using biometrics are investigated. Original recognition methodology is developed for iris hand-written signature, 3D face and EEG. Machine learning research is focused on reinforcement learning, applied to adaptive control and multi-agent systems including very large systems and adaptive network routing. Also, learning in neural networks and modeling granularity is investigated.

Robot Programming Group (**C.Zieliński**, W.Dudek, M.Figat, J. Karwowski, T.Kornuta, D.Seredyński, W.Szynkiewicz, M. Węgierek, T. Winiarski)

Research of the group is concerned with robot control system design and in particular robot programming methods. The group focuses on robot system architectures, their specification and implementation. Service robots are at the centre of interest. The research encompasses manipulation and grasping, especially two handed manipulation, utilizing force and impedance control. It also deals with mobile robot localization and navigation. Special emphasis is placed on sensor-based motion planning and control of single and multiple robots.

Machine Perception Group (**W. Kasprzak**, A. Wilkowski, M. Stefańczyk, P. Piwowarski, Ł. Bala, P. Szelągowski)

The research interests are in pattern recognition and machine learning techniques and their applications to image and speech analysis. Lately, the focus in image analysis is on bridging the semantic gap between object recognition in images/video and ontology-based image and scene representation. For this purpose RGB-D images and 3-D point clouds are intensively being processed. Machine learning techniques are applied for

object detection and recognition in images and video, as well as for speech- and speaker recognition. Besides robot perception systems, the eyed application fields are multimodal human-machine interfaces, automatic surveilance data analysis and biometrics – suitable gesture recognition- and speech/speaker recognition methods are developed and implemented.

Control and Software Engineering Division

Division Head:	Professor P. Tatjewski (until Sept. 2020)
Professors:	P. Domański, M. Ławryńczuk P. Tatjewski
Assistant Professors:	P. Chaber, P. Marusak, S. Plamowski, A. Zalewski
Assistant:	K. Borowa, S. Kijas, R. Nebeluk, A. Wojtulewicz, K. Zarzycki
Senior Lecturers:	J. Gustowski, A. Ratkowski, M. Szlenk
Senior Engineer:	W. Macewicz
Ph.D. Students:	M. Falkowski, D. Rocki, A. Wojtulewicz, M. Okulski, J. Sawulski, G. Mąkosa

Research of the division is conducted in 2 research groups:

Control Engineering Group (**M. Ławryńczuk**, P. Chaber, P. Domański, J. Gustowski, R. Nebeluk, P. Marusak, S. Plamowski, P. Tatjewski, A. Wojtulewicz, M. Okulski, J. Sawulski, K. Zarzycki, M. Falkowski, D. Rocki)

Research of the group concentrates on advanced control engineering techniques and their applications in control of industrial process and in embedded systems. The focus is on model predictive control algorithms, multilayer optimizing and supervisory control, fault detection and fault-tolerant control. Among others, soft computing methods are used in the considered algorithms (neural networks, fuzzy systems and genetic algorithms). The Advanced Control Systems Laboratory offers the possibility to verify developed theoretical solutions. The laboratory is equipped with a set of test processes. For control of industrial process, a Distributed Control System (DCS) cooperating with a Supervisory Control and Data Acquisition (SCADA) software platform and Programmable Logic Controllers (PLC) are used. For control of embedded systems, microcontrollers equipped with numerous sensors and actuators are used.

Software Engineering Group (**A. Zalewski**, K. Borowa, S. Kijas, G. Mąkosa, W. Macewicz, M. Szlenk, A. Ratkowski)

The main area of interest is the development and maintenance of software. Topics include software processes, software analysis and design methods, and the methods for software quality evaluation. New approaches to the assessment of high-level system architecture in the earliest phases of software development are investigated. Methods for architectural decision modeling during the evolution of service-oriented (SOA) systems are developed. Part of the research is aimed at security and trust management issues in distributed open applications.

Operations and Systems Research Division

Division Head:	D. Sc. L. Pieńkosz
Professors:	W. Ogryczak , E. Toczyłowski
Professors, retired:	W. Traczyk, A. P. Wierzbicki
Readers:	T. Traczyk
Assistant Professors:	J. Granat, M. Kaleta, B. Kozłowski, P. Pałka, K. Pieńkosz, A. Stachurski, T. Śliwiński, I. Żółtowska
Assistant:	A. Manujło
Senior Lecturers:	J. Sobczyk, A. Krzemienowski
Ph.D. Students:	R. Karpuk, K. Matela, G. Zalewski, M. Drabecki

Research of the division is conducted in 2 research groups:

Operations Research and Management Systems Group (**K. Pieńkosz**, M. Kaleta, A. Manujło, P. Pałka, E. Toczyłowski, T. Traczyk, I. Żółtowska, M. Drabecki, R. Karpuk)

Research of the group is concerned with operation research and structural discrete optimization methods for control and management of discrete processes, including applications in the network structure development, deregulated electric power industry, IP networks, computer integrated manufacturing, etc. The research is focused on market and auctions design, scheduling techniques, efficient structural-based optimization algorithms, time-table generation, strategic and tactical planning, detailed scheduling, and real-time operational control. Also, the object oriented and relational database management systems and CASE methods are investigated to design of the distributed multi-functional heterogeneous information systems.

Optimization and Decision Support Group (**W. Ogryczak** , J. Granat, B. Kozłowski, A. Krzemienowski, J. Sobczyk, A. Stachurski, T. Śliwiński, K. Matela, G. Zalewski)

Research of the group is focused on the theory of distributed and parallel computational methods, and software for optimization. The theory covers a whole area of linear and non-linear, dynamic, stochastic and multiple criteria problems, and deals with such topics as the sensitivity aspects and the parametric aspects. Another area covers the decision theory, including the multi-person decisions and the game theory, and deals with software building for decision support and organization and management of computer networks.

1.3   Statistical Data

FACULTY and STAFF	2018 persons	2019 persons	2020 persons
Academic Staff	44(+2)	47(+2)	44(+2)
by titles/degrees			
Professors	8	7	5
D.Sc.-s	7	7	9
Ph.D.-s	19(+2)	21(+2)	20(+2)
M.Sc.-s	8	10	10
Others		2	0
by positions			
Professors	9	8	7
Readers	1	1	1
Assistant Professors	19(+2)	21(+2)	21(+2)
Senior Lecturers	6	6	5
Assistants	9	11	10
Ph.D. Students	28	28	24
Technical Staff	3	2	1
Administrative Staff	7	7	8

$+$ – corrections due to persons on long-term leave of absence

ACTIVITIES	2018	2019	2020
Teaching activities			
standard teaching potential, hours	9 785,0	9 980,0	10 755,8
# hours taught	14 097,90	14 043,70	14 449,30
Degrees awarded			
Professor	0	0	0
D.Sc	0	0	2
Ph.D.	1	2	2
M.Sc.	30	59	64
B.Sc.	69	59	68
Research projects			
granted by WUT	5	5	6
granted by State institutions	5	5	4
granted by international institutions	2	4	3
other	5	3	5
Sci.-Tech. publications			
monographs (authored or edited)	2	1	3
chapters in books and proceedings	26	18	37
papers in journals	22	34	41
Reports, abstracts and other papers	1	0	0
Conferences			
participation (# of conferences)	28	27	7
participation (# of part. from ICCE)	65	38	28

RESOURCES	2018	2019	2020
Space (sq.m.)			
laboratories	644	644	644
library + seminar room	182	182	182
faculty offices	821	821	821
Computers			
personal computers	221	234	235
Library resources			
books	3 176	3 188	3 194
booklets	2 959	3 176	3 176
journals subscribed	9	9	9

2 Faculty and Staff

Presentation of our faculty starts with Professors Emeriti and continues with Senior Faculty, Supporting Faculty, Ph.D. Students, and Administrative Staff. Senior Faculty includes Professors, Readers, Assistant Professors, and Senior Lecturers. By Supporting Faculty we understand Lecturers, Assistants, Research Associates, and Software Engineers, as well as Technical Staff. The personal information below regards the period of January 1 – December 31, 2018.

2.1 Professors Emeriti

Władysław Findeisen Professor (retired July 1999)

Systems Control Division, Complex Systems Group

room 524, **tel. 22 234 7397 and 825 0995**

W.Findeisen@ia.pw.edu.pl

M.Sc. 1949, Ph.D. 1954. Full Professor since 1962.

Founder and Director of ICCE (1955–1981), elected and re-elected Rector of WUT (1981–1985). Member of Polish Academy of Sciences (PAN) since 1971. Doctor Honoris Causa of The City University in London (1984), Warsaw University of Technology (1996), Gdańsk University of Technology (1997), Technische Universität Ilmenau (1998). Chairman of the Social Council to the Primate of Poland (1986–90), Vice-President of the Polish Academy of Sciences (PAN)(1990–1992), Senator of the Republic of Poland (1989–93), President of "Kasa Mianowskiego" (a foundation which sponsors foreign scientists in Poland) (1991–2009). Honored with the Order of the White Eagle (2012).

Radosław Ładziński Professor (retired January 1998)

Systems Control Division, Complex Systems Group

R.Ladzinski@ia.pw.edu.pl

M.Sc. 1952, Ph.D. 1957 from WUT; the title of Professor of Technical Sciences awarded in 1968.

With WUT since 1949. Vice-Dean of the Faculty of Electronics, (1964–1969), head of the Ph.D. Program in Control Engineering and Computer Science (1977–1981), chairman of the Electronics and Information Technology Committee for Ph.D. Degree in Control and Computer Engineering (1991–1996). As Professor Emeritus author of the programme and the first lecturer of the two basic Undergraduate Courses: *Dynamic System* and *Control*, both taught in English (1998–2007). Parallel working with Institute of Electrical Engineering of Polish Academy of Sciences (PAN) (1955–1962), and with Institute of Automatic Control of PAN (1963–1968). Post-Doctoral Scholar, Royal Institute of Technology, Stockholm, Sweden (1957), British Council Scholar, University of Cambridge, England (1959–60), Visiting Lecturer, Department of Mathematics, University of Ghana, Accra, Ghana (1962–63), Professor of Engineering Science, University of Mosul, Iraq (1970–74), Professor of Engineering Mathematics, Rivers State University of Science and Technology, Port Harcourt, Nigeria (1981–87), Member of Magdalene College, University of Cambridge, England.

Interests: Dynamic systems, control theory, and applied mathematics.

Krzysztof Malinowski Professor (Head of Division, retired Feb. 2019)

Systems Control Division, Complex Systems Group

room 517, **tel. 22 234 7397 and 22 825 0995**

K.Malinowski@ia.pw.edu.pl, www.ia.pw.edu.pl/~malinows

M.Sc. 1971, Ph.D. 1974, D.Sc. 1978, the title of Professor of Technical Sciences awarded in 1989, appointed to ordinary professorship in 1994.

With WUT since 1971. Director of ICCE (1984–1996), Dean of the FEIT (1996–1999). Member of the Senate of the Warsaw University of Technology (1993–2002), Chairman of the Senate Committee on Academic Staff (1993–1996 and 1999–2002), Chairman of Senate Committee on Research (1996–1999). Member of the Polish Academy of Sciences (PAN) (Corresponding Member 1998–2016, Full Member 2016–), Member of the Warsaw Scientific Society (TNW), Chairman of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN) (2007–2014, Professor in the Research and Academic Computer Network Institute (NASK), Vice-Chairman of the Scientific Council of NASK (2011–2015), Chairman of Task Group of Ministry of Science and Higher Education for assessment of applications for funding large scale research equipment and constructions (2011–2015), Chairman of the Scientific Council of the Industrial Institute for Automation and Measurements (PIAP), Member of the IFAC Technical Committees on Optimal Control and on Large Scale Systems, Chair of the Council of Provost, Division IV: Engineering Science, Polish Academy of Sciences (2015–2018).

Interests: Hierarchical control, model-based predictive control of nonlinear systems, applications of optimization, management and control of computer networks.

Jerzy Pułaczewski Senior Engineer (retired since October 2003)

Systems Control Division, Robot Programming Group

J.Pulaczewski@ia.pw.edu.pl

M.Sc. 1958, Ph.D. 1965 from WUT.

With WUT since 1956, Deputy Director of ICCE (1972–80 and 1993–96), Deputy Dean of the Faculty of Electronics (1981–87), Chairman of the Departmental Curriculum Committee (1981–90), member of the Senate of Warsaw University of Technology (1987–90). Scholarship in Moscow Electroenergy University (1958–59), the British Council scholarship at Cambridge University, UK (1965–66), visiting researcher at Minneapolis University, Minneapolis, MN (1980–81).

Interests: Digital control algorithms, process modeling and simulation, process control.

Jacek Szymanowski Professor (retired January 2000)

Systems Control Division, Complex Systems Group

J.Szymanowski@ia.pw.edu.pl

M.Sc. 1962, Ph.D. 1966, D.Sc. 1983 from WUT.

With WUT since 1968. Visiting Professor, Laboratoire d'Automatique de Nantes, Ecole Centrale de Nantes, France, 1992, 1994, 1995, 1996, 1997. Retired since January 2000.

Interests: Simulation of control systems, linear and nonlinear programming, control applications of optimization techniques, operating systems.

Wiesław Traczyk Professor (retired January 2010)

Operations and Systems Research Division, Optimization and Decision Support Group

W.Traczyk@ia.pw.edu.pl

M.Sc. 1959, Ph.D. 1964, D.Sc. 1969 from WUT, the title of Professor awarded 1983.

With WUT since 1957, Vice-Dean of the Faculty of Electronics (1971–1975), Deputy Director (1975–1981) and Director of ICCE (1981–1984). Member of the Senate of Warsaw University of Technology (1981-1984), Chairman of the Senate Committee of Finances (1981-84). Professor of the University in Port Harcourt, Nigeria (1984-1987), Professor of the Institute of Telecommunications (1997–2006). Chairman of FEIT Committee for Ph.D. Degrees in Automatic Control and Computer Sciences (1990–2005). Head of ICCE Optimization and Decision Support Division (1997-2002).

Interests: Knowledge engineering, expert systems, artificial intelligence.

Andrzej P. Wierzbicki Professor (retired March 2004)

Operations and Systems Research Division, Optimization and Decision Support Group

A.Wierzbicki@ia.pw.edu.pl

M.Sc. 1960, Ph.D. 1964, D.Sc. 1968 from WUT, titles of Professor awarded in 1975 and 1992.

With WUT since 1961, half time since March 1997. Deputy Director of the ICCE (1971-1975), Deputy Dean (1971-1972) and then Dean of FEIT (1975-1978) member of the Senate (1975-1978), member or chairman of many university commissions.

Since 1978 working with the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria and served (1979-1984) as the chairman of the Systems and Decision Sciences Program. Visiting prof. at the University of Minnesota, Minneapolis, MN, Brown University, Providence, RI (1970–1971), Kyoto University, Japan (1989-1990), Fernuniversitaet Hagen (1985) and Japan Advanced Institute of Science and Technology (2004-2007).

Director of the National Institute of Telecommunications in Poland (1996-2004). Chairman of the Commission of Applied Research of the State Committee for Scientific Research (KBN) (1991–1994). Chairman of the Consulting Panel for Promotion and Policy of Science of State Committee for Scientific Research (KBN) (1994-2000), Member of the Consulting Panel for Computer Infrastructure of Science KBN (1994-2000), Chairman of the Consulting Panel for International Scientific Cooperation of State Committee for Scientific Research (KBN) (2000-2004). Chairman of the Scientific Council of the Industrial Institute for Automation and Measurements (PIAP) (1991-2004), chairman of the Scientific Council of Scientific and Academic Computer Network NASK (1994-2004), and member of the Scientific Council of Institute of System Research (IBS PAN) (1992-2004). Member of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN) (1970-2004). Member of the Committee for Future Studies "Poland 2000+" PAN (since 1986, deputy chairman since 2000). Member and deputy chairman of the Panel for Cooperation with IIASA of PAN.

Member of the Polish Association for the Club of Rome. Member of Polish Mathematical Society (PTM) (since 1975) and of Society of Polish Electrical Engineers (SEP) (1970–2004). Member of the Information Society Technology Advisory Group (ISTAG) of the European Commission (2000-2002). Recipient of George Cantor Award of the Int. Soc. of Multi-Criteria Decision Making for his results in multi-criteria optimization theory and

decision support methodology (1992). Recipient of Tomasz Hofmokl Award of NASK for the promotion of informational society, 2005. Recipient of Best Paper Award at the Hawaii International Conference of Systems Science, 2005 for the paper: "Knowledge Creation and Integration: Creative Space and Creative Environments".

Interests: Optimization theory and algorithms, decision theory, decision support systems, negotiation methods and experiences, applications in telecommunication, information society issues, knowledge creation and engineering.

2.2 Senior Faculty

Piotr Arabas Assistant Professor (part-time)

Systems Control Division, Complex Systems Group

room 573, tel. 22 234 7126

P.Arabas@elka.pw.edu.pl

M.Sc 1996, Ph.D. 2004 from WUT

With WUT since 2002.

Interests: Hierarchical systems, predictive control, management of telecommunication services.

Mohammadreza Azimi Assistant (until Oct, 2020)

Systems Control Division, Biometrics and Machine Learning Group

room 560, tel. 22 234 7297

m_r_azimi1991@yahoo.com

With the Faculty of Electronics and Information Technology at Warsaw University of Technology since 2017

Interests: Biometric systems, Speech and Audio Processing, Computational Modeling.

Klara Borowa Assistant (part time)

Control and Software Engineering Division, Software Engineering Group

room 562, tel. 22 234 7756

klara.borowa@pw.edu.pl

M.Sc. 2019 from WUT

With WUT since 2019.

Interests: Software engineering, software architecture, architecture decision making, requirements engineering

Patryk Józef Chaber Assistant Professor

Control and Software Engineering Devision, Control Engineering Group

room 571, tel. 22 234 7861

p.chaber@ia.pw.edu.pl

M.Sc. 2014, Ph.D 2018 from WUT.

Interests: Neural networks, microcontrollers, control algorithms, modelling.

Paweł Domański Assistant Professor (until Jan. 2020), Professor (since Feb. 2020)

Control and Software Engineering Division, Control Engineering Group

room 570, tel. 22 234 7665

P.Domanski@ia.pw.edu.pl

D.Sc. 2018, Ph.D. 1996, D.Sc 2018 from WUT.

With WUT since 1991.

Interests: Adaptive control, intelligent control, fuzzy logic.

Wojciech Dudek Assistant

Systems Control Division, Robot Programming Group

room P109, 566, tel. 22 234 7649

wojciech.dudek@pw.edu.pl, https://www.robotyka.ia.pw.edu.pl/team/wdudek

M.Sc 2015 from WUT

With WUT since 2017

Interests: Mobile robots, navigation, distributed architectures, cloud computing.

Maksym Figat Assistant

Systems Control Division, Robot Programming Group

room 566

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M.Sc. 2013 from WUT.

With WUT since 2008.

Interests: methodology of designing robotic control systems, Petri nets, formal language theory, CAD/CAM systems.

Janusz Granat Assistant Professor

Operations and Systems Research Division, Optimization and Decision Support Group

room 560A, tel. 22 234 7864

J.Granat@ia.pw.edu.pl, www.ia.pw.edu.pl/~janusz

M.Sc. 1986, Ph.D. 1997 from WUT.

With WUT since 1987, chairman of IFIP Working Group TC 7.6, Optimization-Based Computer Modeling and Design

Interests: Decision support systems, multicriteria decision analysis, data warehouses, decision support in telecommunication industry.

Jerzy Gustowski Senior Lecturer

Control and Software Engineering Division, Control Engineering Group

room 525, tel. 22 234 7699

J.Gustowski@ia.pw.edu.pl

M.Sc. 1979 from WUT.

With WUT since 1979.

Interests: Low level software for computer control, interfacing, single-chip microcomputers, PLC controllers.

Mariusz Kaleta Senior Lecturer (until Sept. 2020), Professor (since Oct. 2020)

**Operations and Systems Research Division,
Operations Research and Management Systems Group**

room 561, **tel. 22 234 7123**

M.Kaleta@ia.pw.edu.pl

M.Sc. 2000, Ph.D. 2005, from WUT

With WUT since 2003.

Interests: Discrete optimization, operations research and management, decision support in energy market.

Mariusz Kamola Assistant Professor (part-time)

Systems Control Division, Complex Systems Group

room 573, **tel. 22 234 7126**

M.Kamola@ia.pw.edu.pl, www.ia.pw.edu.pl/~mkamola

M.Sc. 1997, Ph.D. 2004 from WUT.

With WUT since 2002.

Interests: Modeling and simulation, optimization, parallel computation, data networks, social networks.

Andrzej Karbowski Assistant Professor

Systems Control Division, Complex Systems Group

room 572, **tel. 22 234 7632**

A.Karbowski@ia.pw.edu.pl, www.ia.pw.edu.pl/~karbowsk

M.Sc. 1983, Ph.D. 1990. D.Sc. 2012 from WUT

With WUT since 1983. Research visitor: Politecnico di Milano and Universita di Genova, 1992, Edinburgh Parallel Computing Centre, 2000.

Interests: Cybersecurity, large scale systems, distributed computations, optimal control and management in risk conditions, decision support systems, neural networks, environmental systems management, control and decision problems in computer networks.

Michał Karpowicz Assistant Professor (part time)

Systems Control Division, Complex Systems Group

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M.Sc. 2005, Ph.D. 2010, D.Sc 2020 from WUT

With WUT since 2014

Interests: Control theory, game theory, computer networks, cybersecurity

Włodzimierz Kasprzak Professor

Systems Control Division, Machine Perception Group

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W.Kasprzak@elka.pw.edu.pl, www.ia.pw.edu.pl/~wkasprza

M.Sc. 1981, Ph.D. 1987 from WUT, Dr-Ing. 1997 from Univ. of Erlangen-Nuremberg, D.Sc. 2001 from WUT, the title od Professor awarded in 2014.

With WUT since 1997, Professor since 2005. Member of Polish Section of IAPR.

Interests: Computer vision, speech recognition, pattern classification, signal analysis, artificial intelligence.

Szymon Kijas Assistant (part time)

Control and Software Engineering Division, Software Engineering Group

room 555, **tel. 22 234 7997**

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Ph.D. 2019 from WUT

With WUT since 2019

Tomasz Kornuta Assistant Professor (on leave)

Systems Control Division, Robot Programming Group

T.Kornuta@elka.pw.edu.pl, http://tkornuta.googlepages.com

M.Sc. 2005, Ph.D 2013 from WUT.

With WUT since 2008.

Interests: Robot programming methods, behavioral control, computer vision, pattern classification, artificial intelligence.

Adam Kozakiewicz Assistant Professor (part time)

Systems Control Division, Complex Systems Group

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akozakie@elka.pw.edu.pl

M.Sc. 2001, Ph.D. 2008 from WUT

With WUT since 2006.

Interests: Computer networks, distributed computation, network and systems security.

Bartosz Kozłowski Assistant Professor (on leave)

Operations and Systems Research Division, Optimization and Decision Support Group

B.Kozlowski@elka.pw.edu.pl

M.Sc. 2004 from WUT.

With WUT since 2010.

Interests: Computer networks, data bases, operating systems, programming languages, text processing.

Tomasz Jordan Kruk Assistant Professor

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M.Sc. 1994 from Technical University of Gdańsk. Ph.D. 1999 from WUT.

With WUT since 1999. Since 2018 cybersecurity expert of PIIT (The Polish Chamber of Information Technology and Telecommunications)

Interests: Operating systems, computer and network security, distributed systems.

Adam Krzemienowski Senior Lecturer

Operations and Systems Research Division, Optimization and Decision Support Group

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A.Krzemienowski@ia.pw.edu.pl

Ph.D. 2007 from WUT.

With WUT since 2007. Visiting Lecturer at the University of Leeds, United Kingdom (2007–2008).

Interests: Optimization and decision support under risk, risk measures, stochastic programming.

Maciej Ławryńczuk Professor (Leader of the Group), (Deputy Director of the Institute)

Control and Software Engineering Division, Control Engineering Group

room 563, **tel. 22 234 7124**

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M.Sc. 1998, Ph.D. 2003, D.Sc. 2013 from WUT.

With WUT since 2003. Twice awarded of "Gold chalk" („Złota kreda") award. The coordinator of B.Sc. and M.Sc. studies in automation and robotics since 2011.

Interests: advanced process control algorithms, in particular Model Predictive Control (MPC) algorithms, set-point optimisation algorithms, artificial intelligence and soft computing techniques, in particular neural networks, modelling and simulation.

Andrzej Manujło Assistant

Operations and Systems Research Division, Operations Research and Management Systems Group

room 556

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M.Sc. 2015 from WUT.

With WUT since 2009.

Interests: Machine Learning, Energy Clusters

Piotr Marusak Assistant Professor

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M.Sc. 1997, Ph.D. 2003, D.Sc 2020 from WUT.

With WUT since 2002.

Interests: Predictive control of nonlinear systems, digital control algorithms, process modeling and simulation, fuzzy control.

Robert Ryszard Nebeluk Assistant

Control and Software Engineering Devision, Control Engineering Group

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M.Sc. 2019 from WUT

With WUT since 2019

Interests: Modelling, control algorithms, optimization.

Jalil Khiarak Nourmohammadi Assistant

Systems Control Division, Biometrics and Machine Learning Group

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B.Sc. 2011, M.Sc. 2015

M.Sc. degree in Artificial Intelligence from the Faculty of Electrical & Computer Engineering, University Of Tabriz, Tabriz, Iran in 2015.

Interests: Biometric, Machine Learning, Computer Vision, Deep learning, and Neural Networks.

Ewa Niewiadomska-Szynkiewicz Professor (Leader of the Group)

Systems Control Division, Complex Systems Group

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M.Sc. 1986, Ph.D. 1995, D.Sc. 2005 from WUT, the title of Professor of Technical Science awarded in Feb. 2017. Member of the Foundation for the Promotion of Science Systems Polish Academy of Sciences (2017-)

Research Assistant at the Institute of Geophysics of Polish Academy of Sciences in (1987–1988), with WUT since 1988, NASK since 2001, NASK Director for Research since 2009, IEEE Member. Member of of the Scientific Council of NASK since 2002 (Vice-Chairman 2008–2009).

Interests: Large scale systems, computer simulation, computer aided control systems design, environmental systems management, distributed computations, global optimization, telecommunication systems, ad hoc networks.

Ekspert of the Polish Accreditation Committee, Member of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN)., Member of the Foundation for the Promotion od Science system of PAN

| **Włodzimierz Ogryczak** | Professor (Director of the Institute, Leader of the Group)

Operations and Systems Research Division, Optimization and Decision Support Group

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M.Sc. 1973, Ph.D. 1983 in Mathematics from Warsaw University, D.Sc. 1997 in Computer Science from PAN, the title of Professor of Technical Sciences awarded in 2011.

With Warsaw University, Institute of Informatics 1973–2000, with WUT since 2000. H.P. Kizer Eminent Scholar Chair in Computer Science at Marshall University, USA (1989–1992), visiting professor at Service de Mathématique de la Gestion of Université Libre de Bruxelles, Brussels, Belgium (1994–1995). Member of INFORMS, International Society of MCDM, GARP, Expert of The Polish Accreditation Committee.

Interests: Computer solutions and interdisciplinary applications in the area of operations research, optimization and decision making with the main stress on: multiple criteria analysis and decision support, decision making under risk, linear, network and discrete programming, location and distribution problems.

Andrzej Pacut Professor (Leader of the Group (part time))

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A.Pacut@ia.pw.edu.pl, www.ia.pw.edu.pl/~pacut

M.Sc. 1969, Ph.D. 1975, D.Sc. 2000 from WUT, the title of Professor of Technical Sciences awarded in December 2010.

With Warsaw University of Technology since 1969, first with the Institute of Mathematics (until 1978) then with ICCE. Visiting Assistant Prof. at Lefschetz Center for Dynamical Systems of Brown University, Providence, RI (1980–1981), Visiting Associate Prof. at Oregon State University, Corvallis, OR (1984 and 1986–1991). Deputy Director of ICCE 1985–1986 and 1993–2005. Senior Member of IEEE. Vice Chairman (2001–2005) and Chairman (2006–2009) of the IEEE Poland Section, Chair of Tech. Committee No. 309 on Biometrics (2010–) and expert of Tech. Committee No. 182 on Information Security in IT Systems (2003–) of Polish Normalization Committee (PKN). Head of the NASK Biometric Laboratories (2003–), member of NASK Research Council (2007–), vice-chair (2009–2011). Member of Scientific Council of Central Laboratory of Criminology (2011–).

Interests: Learning systems, system identification, biometrics, neural modeling, neural networks.

Piotr Pałka Assistant Professor

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M.Sc. 2005, Ph.D. 2009 from WUT.

 With WUT since 2009. Member of the Rector's Team for the Innovative Forms of Education (2014–). Expert of Ministry of Economic Development on Industry Transformation (2016–2017).

Interests: multi-agent systems, agent-based modeling, smart cities, distributed decision systems, auction theory, IoT, innovative forms of education, problem based learning, design thinking.

Krzysztof Pieńkosz Assistant Professor, Head of Division, Leader of the Group

**Operations and Systems Research Division,
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M.Sc. 1984, Ph.D. 1992, D.Sc. 2011 from WUT.

 With the Research Institute of Polish Gas and Oil Company 1984–1986, with WUT since 1986.

Interests: Operations research in particular discrete optimization, combinatorial algorithms, production planning and scheduling in manufacturing systems.

Sebastian Plamowski Assistant Professor

Control and Software Engineering Division

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S.Plamowski@ia.pw.edu.pl

M.Sc. 2000, Ph.D. 2006 from WUT.

With WUT since 2015.

Interests: Modeling and simulation, optimization, diagnostics, predictive control, SCADA and DCS systems.

Andrzej Ratkowski Senior Lecturer

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A.Ratkowski@ia.pw.edu.pl

M.Sc. 2005, Ph.D. 2011 from WUT.

With WUT since 2009.

Interests: Software engineering, Service Oriented Architecture, performance engineering, TT architectures.

Dawid Seredyński Assistant

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M.Sc. 2012 from WUT.

With WUT since 2012.

Interests: grasp planning, manipulation planning

Jerzy Sobczyk Senior Lecturer

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J.Sobczyk@ia.pw.edu.pl, www.ia.pw.edu.pl/~jurek

M.Sc. 1985 from WUT.

With WUT since 1984. FEIT Network Administrator.

Interests: Computer networks, system and network administration, programming languages, web applications, parallel and distributed programming, multi-criteria optimization.

Andrzej Stachurski Assistant Professor

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A.Stachurski@ia.pw.edu.pl, www.ia.pw.edu.pl/~stachurs

M.Sc. 1976, Ph.D. 1980, D.Sc 2013 from WUT.

Senior Assistant (1979–80) and then Assistant Professor (1980–92) at the Institute of System Research (IBS PAN), with WUT since 1992. Visiting Professor at the Calabria University, Italy, 1984, Äbo Swedish Academy in Turku, 1987, Jyväskylä University, Finland, 1988, JSPS invitee at the Department of Control Engineering, Osaka University, Japan, 1988–89. Member of Polish Society of Operations and Systems Research. Author and co-author of many scientific papers and reports on optimization algorithms, identification, applications of optimizations in macro-economy modeling and optimal design problems in structural engineering. Co-author of a textbook 'Podstawy optymalizacji' ('Foundations of Optimization') published in 1999. Reviewer of Control & Cybernetics, Optimization, Archives of Control Science, SIAM J. on Optimization, IEEE Concurrency.

Interests: Interests: nonlinear programming, large-scale optimization, applications to the optimal design problems in structural engineering, parallel and distributed calculations in Mathematical Programming.

Maciej Stefańczyk Assistant

Systems Control Division, Machine Perception Group

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M.Stefanczyk@elka.pw.edu.pl

M.Sc 2011

With WUT since 2011

Interests: Computer vision, computer graphics.

Marcin Szlenk Senior Lecturer

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M.Sc. 2000, Ph.D. 2006 from WUT.

With WUT since 2005.

Interests: Software modeling, programming paradigms.

Wojciech Szynkiewicz Assistant Professor

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M.Sc. 1985, Ph.D. 1996 from WUT, D.Sc. 2016 from WUT.

With WUT since 1985. Deputy Director of the Research Center for Control and Information-Decision Technology (1999–2003).

Interests: Robotics, multiple robots coordination, robot sensor-based manipulation and motion planning, autonomous navigation, real-time systems.

Tomasz Śliwiński Assistant Professor

Operations and Systems Research Division, Optimization and Decision Support Group

room 561, **tel. 22 234 7123**

T.Sliwinski@ia.pw.edu.pl

M.Sc. 1999, Ph.D. 2007 from WUT.

With WUT since 2004.

Interests: Discrete optimisation, operations research, decision support.

Piotr Tatjewski Professor (Head of Division (until Sept, 2020) (part time))

Control and Software Engineering Division, Control Engineering Group

room 524, tel. 22 234 7397 and 825 0995

P.Tatjewski@ia.pw.edu.pl

M.Sc. 1972, Ph.D. 1976, D.Sc. 1988, the title of Professor of Technical Sciences awarded in 2003, appointed to ordinary professorship in 2006

With Warsaw University of Technology since 1972. Head of Control Engineering Group 1991–2015, Deputy Director of ICCE for Academic Affairs (1987–1991), Director of ICCE 1996–2008. Vice Dean for Research of the Faculty since 2012. Head of Control and Software Engineering Division, Head of the Undergraduate Degree Program in Computer Control Systems (1994–1996). DAAD scholarship in 1978 (TU Hanover), SERC research fellow at the City University, London (1986), visiting professor at the University of Birmingham (1992/1993). Member of Committee of Control and Robotics of Polish Academy of Sciences since 2004, Chair of the Automatic Control Systems Section of this Committee (2007–2015), Member of the Control and Robotics Section of the Scientific Research Council (KBN) 1997–2004. Member of Programme Committee of Int. Journal of Applied Mathematics and Computer Science, Journal of Automation, Mobile Robots and Intelligent Systems, Member of Advisory Board of ISA Transactions (2011–), Expert of Ministry of Education and Science for Educational Standards (2005–2006). Member of EUCA (European Union Control Association) Administrative Council (2008–2011), member of IFAC Technical Committees TC 2.1 and TC 5.4, Member of the Scientific Council of Systems Research Institute of Polish Academy of Sciences (2007–), vice-chairman of the Scientific Council (2011–2018). Member of the Polish Central Commision for Degrees and Titles (2017–2020).

Interests: Advanced process control and optimization, model based predictive control, multi-layer control systems, decomposition methods in optimization and control, soft computing methods.

Eugeniusz Toczyłowski Professor (retired Oct. 2020)

**Operations and Systems Research Division,
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M.Sc. 1973, Ph.D. 1976, D.Sc. 1989 from WUT, the title of Professor of Technical Sciences awarded in 2004.

With WUT since 1973. Head of Operations Research and Management Systems Division, Vice-Dean of the Faculty of Electronics at WUT (1990–1993), chairman of the Rector's Committee for University Computerization (1993–1999), Advisor to the Dean on Strategic Planning (1993–1996). Head of the Undergraduate Program in Information Systems for Decision Support (1992–2004). Member of the Section on Decision Support (since 1992) and the Section on Knowledge Engineering and Operations Research (2003–) of the Committee of Automation and Robotics of Polish Academy of Sciences, Member of the Scientific Council of the Systems Research Institute (IBS PAN) (since 2002), Member of Consulting Council EnergoProject S.A. (2003–2004), Member of Steering Committee of the Energy Market (2003–2004). Member of the Polish National Council for CO_2 Reduction Emission Program, and Head of the Energy Market Group (2009–), Member of the European Commission DG Advisory Group for Energy Roadmap 2050 (2011–).

Interests: Structural approaches to discrete optimization, operations research and management, management information systems, auction theory, competitive market design under constraints, low carbon economy design.

Tomasz Traczyk Reader (Deputy Director of the Institute)

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M.Sc. 1984, Ph.D. 1992 from WUT.

With WUT since 1984.

Interests: Applications of databases in management and control, software for high-energy physics, long-term digital archives.

Mateusz Trokielewicz Assistant Professor (part-time)

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System Control Division, Biometric and Machine Learning Group

room 558, **tel. 22 234 7805**

m.trokielewicz@elka.pw.edu.pl

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Interests: biometrics, iris recognition, machine intelligence, pattern recognition

Artur Wilkowski Assistant Professor

<div align="right">

Systems Control Division, Machine Perception Group

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M.Sc Eng 2004, Phd 2012 from WUT

With WUT since 2006

Interests: Computer vision, Machine learning.

Tomasz Winiarski Assistant Professor

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M.Sc. 2002, Ph.D. 2009 from WUT.

With WUT since 2004.

Interests: Robot control systems, artificial intelligence, mobile robots, impedance control, manipulator force control, service robots, social robots

Andrzej Marcin Wojtulewicz Assistant

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room 571, **tel. 22 234 7861**
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M.Sc. 2014, Ph.D 2020 from WUT

With WUT since 2016

Interests: Control theory, FPGA, microcontoller.

Andrzej Zalewski Assistant Professor (Leader of the Group, Head of Division)

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A.Zalewski@ia.pw.edu.pl

M.Sc. 1997, Ph.D. 2003, D.Sc 2015 from WUT.

With WUT since 2002. Member of Information Systems Audit and Control Association (ISACA).

Interests: Software engineering, real-time systems, timing requirements, concurrent systems, performance analysis for computer systems, IT project economics.

Krzysztof Zarzycki Assistant

Control and Software Engineering Division, Control Engineering Group
room 571, **tel. 22 234 7861**
krzysztof.zarzycki@pw.edu.pl

M.Sc. 2020 from WUT.

With WUT since 2020.

Interests: Process modelling, model predictive control, neural networks.

Cezary Zieliński Professor (Leader of the Group, Head of Division (until Sept. 2020))

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M.Sc. 1982, Ph.D. 1988, D.Sc. 1996 from WUT, the title of Professor of Technical Sciences awarded in 2012.

With WUT since 1985. Research visitor at Loughborough University of Technology, UK (1990, 1992), Senior Fellow at Nanyang Technological University, Singapore (1999–2001), Secretary of Priority Research Program in Control, Information Technology, and Automation (PATIA) (1994–1999). Member of the Forecast Committee of the Polish Academy of Sciences: Poland 2000 Plus (2003–2007, 2015–). Senior Member of IEEE (2002–), Vice Chairman of the Scientific Committee of the Industrial Research Institute for Automation and Measurement PIAP (2016–2017). Vice Dean for Research and International Cooperation FEIT (2002–2005), Head of ICCE Robot Programming and Pattern Recognition Group since 1996 (currently Robot Programming Group). Member of the board of EURON (European Robotics Network of Excellence, 2004–2008). Deputy Director of ICCE for Research (2005–2008), Director of ICCE (2008–2016), Vice Dean for General Affairs (2016–). Member of the Control and Robotics Committee of the Polish

Academy of Sciences (2007–). Editor in Chief of Measurements-Automation-Robotics Technical Sciences Quarterly (PAR) (2017–). Head of Warsaw University of Technology Centre for Priority Research Area Artificial Intelligence and Robotics, established within the Excellence Initiative: Research University (IDUB) programme (2020–)

Interests: Robot programming methods, open-structure robot controllers, behavioral control, digital systems.

Izabela Żółtowska Assistant Professor

**Operations and Systems Research Division,
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I.Zoltowska@elka.pw.edu.pl, home.elka.pw.edu.pl/~imilenko

M.Sc. 2000, Ph.D. 2006 from WUT.

With WUT since 2005.

Interests: Operations, planning and economics of electric energy systems, optimization theory and its applications.

2.3   Supporting Faculty and Staff

Włodzimierz Macewicz Senior Software Engineer

Control and Software Engineering Division, Software Engineering Group

room 525, **tel. 22 234 7699**

W.Macewicz@ia.pw.edu.pl

M.Sc. from WUT.

With WUT since 1983.

Interests: Computer networks, data bases, operating systems, programming languages, text processing.

Sylwia Piskorska R&D Specialist

room 530, **tel. 22 234 6156**

S.Piskorska@elka.pw.edu.pl, sylwia.piskorska@pw.edu.pl

M.Sc. 2002 from Technical University of Gdańsk.

With WUT since 2010. Effective project coordinator, works to assist project managers teams with the coordination of resources, equipment, meetings, and information. Organize projects with the goal of getting them completed on time and within budget. Makes sure all aspects of the project run smoothly and efficiently. Works with various members of the project team and the client to develop a time line, create schedules, and oversee progress to make sure goals are met on time.

Interests: Program and projects – defence and security, Strategic R&D programs, Horizon 2020, Horizon Europe, European Founds, National Programs (creation of modern solutions and technologies increasing innovation).
Certified in: Prince 2 Practitioner, Management of Risk

2.4   Ph.D. Students

Łukasz Bala Ph.D. Student

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Supervisor: Włodzimierz Kasprzak

Ewelina Bartuzi Ph.D. Student

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Mariusz Drabecki Ph.D. Student

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Wojciech Dudek Ph.D. Student

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Supervisor: Wojciech Szynkiewicz

Michał Falkowski Ph.D. Student

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Supervisor: Paweł Domański

Maksym Figat Ph.D. Student (until Feb. 2020)

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Mateusz Mariusz Krzysztoń Ph.D. Student (until Sept. 2020)

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Supervisor: Ewa Niewiadomska-Szynkiewicz

Kamila Matela Ph.D. Student

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Supervisor: Andrzej Zalewski

Michał Okulski Ph.D. Student

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Supervisor: Maciej Ławryńczuk

Paweł Piwowarski Ph.D. Student

Systems Control Division, Machine Perception Group

Supervisor: Włodzimierz Kasprzak

Dariusz Rocki Ph.D. Student

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Supervisor: Paweł Domański

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3 Teaching Activities – Academic Year 2019/2020

3.1 Undergraduate and Graduate Studies

Course Title	Course code	Hours per week	Lecturer	Notes
Administration of UNIX and TCP/IP	ASU	2 – 1 –	J.Sobczyk (fall)	
Advanced Process Control Techniques	TAP	2 – – 2	P.Tatjewski (spring)	
Algorithms and Data Structures	AISDI	2 – 1 –	A.Zalewski (spring)	
Automation and Engineering Measurements in Industry	AP	1 – 1 –	P. Domań ski (fall)	
Optimization Algorithms and Methods	AMO	2 – – 2	A.Stachurski (fall)	
Anatomy of Robots	ANRO	1 – 2 –	T.Winiarski (spring)	
Systems Architecture and Integration	AIS	2 – 1 –	A.Ratkowski (spring/fall)	
Automation and Robotics Equipment	APA	2 – 1 –	T.Winiarski (fall)	
Basics In Automatics	PODA	2 – 1 –	M.Ławryńczuk (fall) P.Marusak (spring)	
Biometric Identity Verification	BIT	2 – 1 –	M.Trokilewicz (spring/fall)	
Commercial Data Bases 2	KBD2	2 – – 2	T.Traczyk (fall)	
Computer Networks	ECONE	2 1 1 –	J.Sobczyk (spring)	
Computer Networks (I)	SKM	2 – 1 1	J.Sobczyk (spring/fall)	
Computer Vision	ECOVI	2 1 – –	W.Kasprzak (fall)	
Control Theory	TST	2 1 – 1	M.Karpowicz (fall)	
Data Bases 2	BD2	2 – – 1	T.Traczyk (spring/fall)	
Decision Support	WDEC	2 – 2 –	J.Granat (spring/fall)	
Decision Support Under Risk Conditions	WDWR	2 – – 1	A.Krzemienowski (spring)	
Distributed Operating Systems	RSO	2 – 1 –	T.Kruk (spring)	
Dynamic systems and control	EDYCO	2 1 1 –	P.Domański (spring/fall)	
Event programming (I)	PROZ	2 – – 1	M.Kamola (fall)	
Fundamentals of Digital Technology	PTCY	2 – 2 –	C.Zieliński (Spring)	
Fundementals of Operation Research	POBO	2 – 1 –	K.Pieńkosz (spring)	
Fundamentals of Parallel Computation	PORR	2 – – 2	E.Niewiadomska--Szynkiewicz (fall)	
Image and Speech Recognition	EIASR	2 1 – 1	W.Kasprzak (fall)	
Information Project Management	ZPI	2 – – 1	K.Pieńkosz (spring/fall)	
Intelligent Robotic System	ISR	2 – 1 –	C.Zieliński (fall)	
Introduction to Automatic Control, Electronics and Telecommunication	WAET	2 – – 1	M. Ławryńczuk, W. Szynkiewicz (spring)	
Introduction to Robotics	WR	2 – 2 –	W.Szynkiewicz (spring/fall)	
Numerical Methods (J)	MNUM	2 – – 1	P.Tatjewski (spring/fall)	
Numerical Methods	ENUME	2 – – 2	P.Marusak (fall)	
Management IT Systems	SIZ	2 – – 2	J.Granat (spring/ fall)	
Methods for Identification	MI	2 – – 1	P.Domański (spring)	
Modeling and Control of Manipulators	EMOMA	3 1 – –	C.Zieliński (fall)	
Modelling and Identification	MODI	2 1 – 1	P.Domański (spring/fall)	
Modeling and Control of Robots	MORO	2 – – 1	C.Zieliński (fall)	
Modeling and Computer Simulation	MISK	2 – -2	E.Niewiadomska--Szynkiewicz (spring)	
Multi-Agent decision support systems	WSD	2 – – 2	P.Pałka (fall)	
Networks Systems Control	SST	2 – – 1	M.Karpowicz (spring)	
Object Programming	PROI	2 – 2 –	T.Śliwiński (fall)	

Course Title	Course code	Hours per week	Lecturer	Notes
Operating System	EOPSY	2 1 1 –	T.Kruk (spring)	
Operating Systems	SOI	2 – 2 –	T.Kruk (fall)	
Optimization and Decision Support	OWD	2 – – 1	W.Ogryczak (fall)	
Parallel Numerical Methods	EPNM	2 – – 2	A.Stachurski (spring)	
Process Control	STP	2 1 1 –	M.Ławryńczuk (fall) P.Marusak (spring)	
Process Management and Scheduling	ZAH	2 – 2 –	I.Żółtowska	
Programming Fundamentals	EPFU	2 1 1 –	M.Kaleta (spring/fall)	
Programmable Controllers	SP	2 – 1 –	J.Gustowski (spring/fall)	
Real-time Systems	ERTS	2 – 2 1	T.Kruk (fall)	
Real-time Systems	SCZR	2 – 2 –	T.Winiarski (spring/fall)	
Robot Programming Methods	EPRM		C.Zieliński (spring)	
Signal Processing	ESPRO	2 1 – –	W.Kasprzak (fall)	
Software Engineering	IOP	2 – 1 –	M.Szlenk (spring/fall)	
Software Specification and Design	SPOP	2 – 1 –	M.Szlenk (spring/fall)	
Soft Computing in Process Control	SZAU	2 – – 2	M.Ławryńczuk, P.Marusak (fall)	
Techniques for Social Network Analysis	TASS	2 – – 2	P.Arabas (fall)	
Team Project 1	PZSP1	– 2 2	M.Kaleta, P.Pałka (spring/fall)	
Microprocessor control systems	SMS	2 – 2 –	M.Ławryńczuk (fall)	
Development of process control systems – group project	PUST	– 1 1 2	M.Ławryńczuk (spring)	
Neural Networks	SNR	2 – – 2	A.Pacut (spring/fall)	
Machine Perception	PERM	2 – 1 –	W.Kasprzak (spring)	
DCS and SCADA systems	DCS	2 – 2 –	S.Plamowski (fall)	
Diagnostics of Industrial Processes	DIPR	1 – 1 –	S.Plamowski, P.Marusak (fall)	
Robot Control and Simulation	STERO	– 2 2	T.Winiarski (fall)	
Automation and Engineering Measurements	APP	1 – 1 –	P.Domań ski (fall)	For the Faculty of Chemistry
Fundamentals of Information Technology	PI	1 2 – –	A.Wilkowski (fall)	For the Faculty of Geodesy and Cartography
Case Studies	WZB	1 – – 1	M.Trokilewicz (fall)	For the Faculty of Mathematics and Information Science
Computer Networks	CN	2 – 1 –	J.Sobczyk (fall)	For the Faculty of Mathematics and Information Science
Image and Speech Recognition	ISR	2 1 1 –	W.Kasprzak (fall)	For the Faculty of Mathematics and Information Science
Data Bases	BD	1 – – –	T. Traczyk (spring)	For the Faculty of Geodesy and Cartography
Databases and Data Warehouses	BHD	2 – 1 –	T.Traczyk (spring)	For the Faculty of Physics
Team Project 1	PZSP1	– 2 2	M.Kaleta, P.Pałka (spring/fall)	

Course Title	Course code	Hours per week	Lecturer	Notes
Electronics and Telecommunication	WAET	2 – – 1	M.Ławryńczuk, W.Szynkiewicz (spring), P.Marusak, W.Szynkiewicz (fall)	

Table explanations

Hours per week

The digits in a four-digit code denote number of hours per week of, consecutively: lectures, tutorials, laboratory hours and project hours (for instance, [2 – 1 1] corresponds to two hours of lectures, no tutorials, one hour of laboratory and one hour of project per week).

3.2 Extramural Graduate Studies

Postgraduate studies **IT Resources Management: architectures, processes, standards, quality** are designed to provide students with current knowledge necessary for successful management of IT in modern organizations. The programme comprises: IT project management, quality standards and assurance systems, development methodologies, system testing, IT audit, business process modeling, system architectures and managerial skills. The classes take form of lectures, workshops, exercises and laboratories.

Postgraduate studies **Project Management: Standards, Practice, Techniques and Tools** merge theoretical knowledge with practical skills necessary for successful project management. The program encompasses: business case and project efficiency assessment, basic project management standards: PMBoK, PRINCE2, IPMA, specialized project management methods e.g. for IT (software development methods including agile approaches), automotive or construction industries, soft-skills like facilitation, negotiations, conflict management, public relations for project management, hard skills like project planning, scheduling, budgeting.

Postgraduate studies **Designing Information Systems with Databases** are intended for IT specialists, who want to acquire new skills in field of design and development of databases and information systems based on them. The programme contains: modeling of processes and data structures, basics of databases usage, engineering of information systems, data management systems, development of applications in systems with databases. The classes take form of lectures and laboratories.

3.3 Graduate Distance Learning

Starting from academic year 2005/2006 our institute is involved in graduate distance learning programme of WUT (named **OKNO**). We coordinate two specializations: Engineering of Internet Systems and Decision and Management Support Systems. The graduates of the first one are prepared for designing, implementing and taking care of complex information technology and computing systems using possibilities offered by contemporary computer networks. They have also ability to manage the layers of technology involved in the next generation of massive system deployments. The graduates of the latter are prepared for designing and implementing software systems which assist in managing, planning and decision making. Their skills and knowledge enable to manage the layers of technology involved in the new generation of intelligent systems empowering every aspect of business operations. First Ms.Sc. degree was awarded in the year 2008.

4 Projects

[PR1] EU Grant No. 675087: **AMBER – enhAnced Mobile BiomEtRics.**

Granting period: 01–01–2017 31–12–2020.

Principal investigator from WUT: Andrzej Pacut.

Investigators: Mateusz Trokielewicz, Sylwia Piskorska.

Aim of the project: AMBER is a Marie Skłodowska-Curie Innovative Training Network addressing a range of current issues facing biometric solutions on mobile devices. AMBER will comprise ten integrated Marie Skłodowska-Curie Early Stage Researcher (ESR) projects across five EU universities. The Network has the direct support of seven Industrial Partners. The aim of the Network is to collate Europe-wide complementary academic and industrial expertise, train and equip the next generation of researchers to define, investigate and implement solutions, and develop solutions and theory to ensure secure, ubiquitous and efficient authentication whilst protecting privacy of citizens. Keywords: biometrics, mobile platforms, usability performance, privacy, security and confidence

[PR2] NCBiR Grant No. AAL2/2/INCARE/2018: **Integrated Solution for Innovative Elderly Care INCARE, in International call: "AAL 2017 Call – AAL packages/Integrated solutions – Packages integrating different solutions based on ICT to support active, healthy and independent living of older adults"**

Granting period: 01–10–2018 31–12–2021.

Principal investigator from WUT: Tomasz Winiarski.

Investigators from WUT: Tomasz Winiarski, Wojciech Dudek, Dawid Seredyński, Maciej Stefańczyk, Maciej Węgierek, Maciej Bogusz, Jerzy Kołakowski (IRE), Cezary Zieliński, Wojciech Szynkiewicz, Włodzimierz Kasprzak, Maksym Figat, Łukasz Zielinski, Daniel Giełdowski, Dawid Gruszczyński, Jakub Sikora, Krystian Chachuła, Vitomir Djaja-Jośko (IRE), Jacek Cichocki (IRE), Marcin Kołakowski (IRE).

Aim of the project: Project main objective is to build upon two successful platforms (AAL-NITICS and FP7-RAPP) a new readily available product whose seamless operability and modularity are demonstrated in extensive end-user pilots that help its fast uptake by the market. We will start from previously validated user insights and will use a co-creation approach to tune the INCARE solution. Pilots carried out in three different countries, i.e. Poland, Slovenia and Hungary, will not only aid the development but will also bring evidence about the effectiveness of the INCARE solution. At larger scale, our aim is to increase awareness and strengthen the trust of primary, secondary and tertiary users (especially policy makers) in the positive effects and huge potential of high-tech AAL solutions, including realistic use of robotic platforms.

Expected results: INCARE, when taken up by the market, has the potential to sustain or even improve the quality of life of elderly in different dimensions and throughout the ageing process, i.e. Living a healthy, active and meaningful life, Living independently and safely for longer at home with support from their caregivers and community when needed, Living in dignity and satisfaction. From the point of view of caregiver the project is to: Reduce stress and care burden, Build resilience, Improve quality, efficiency and effectiveness of care.

Keywords: social robot, elderly care.

[PR3] NCBiR Grant No. CYBERSECIDENT/369195/INCBR/2017: **National Cybersecurity Platform NPC.**

Granting period: 01–09–2017 31–08–2020.

Contractors: NASK-PIB (leader), Warsaw University of Technology, National Institute of Telecommunications, National Centre for Nuclear Research.

Principal investigator from WUT: Ewa Niewiadomska-Szynkiewicz.

Investigators from WUT: Adam Kozakiewicz, Michał Karpowicz, Piotr Arabas, Włodzimierz Kasprzak, Wojciech Szynkiewicz, Cezary Zieliński, Tomasz Winiarski, Maciej Stefańczyk, Wojciech Dudek, Maciej Węgierek, Maksym Figat, Jan Figat, Dawid Seredyński.

Aim of the project: The goal of the Project is to develop a comprehensive, integrated system for continuous monitoring, detection, and warning of threats identified in a near real-time in the State's cyberspace.

Expected results: A prototype of a National Cybersecurity Platform (NCP) comprised of an Operational Centre (OC) and components that integrate participants of the NCP with the OC will be the main outcome of the Project. The NCP prototype, proven in operational environment, will provide nationally coordinated actions to prevent, detect and mitigate the impact of incidents that violate the security of ICT systems vital to the functioning of the State. Moreover, the NPC platform will create opportunities for sharing cyber security awareness within the European Union.

Keywords: cybersecurity, cybersecurity data mining, visualization of threats, risk assesment, NIS.

[PR4] NCBiR Grant APAKT No. CYBERSECIDENT/455132/III/NCBR/2020: **Online child abuse reacting system emphasizing child pornography**

Granting period: 01–06–2020 31–05–2023.

Principal investigator: Włodzimierz Kasprzak. Investigator: Wojciech Szynkiewicz, Artur Wilkowski, Maciej Stefańczyk.

Aim of the project: The research goal of the APAKT project is to develop artificial intelligence methods for analyzing threats in cyberspace consisting of the offering of multi-media content (including attacking by such content) and texts depicting the sexual exploitation of children, namely, a pornographic content involving children, erotic content involving children, pornographic content with created child's image (hereinafter referred to as illegal content) and adult pornography that in an obvious way threatens children (hereinafter referred to as the sensitive content). It is expected to use deep neural networks and other machine learning techniques supported by classic techniques of automatic recognition and verification of multi-media content (text, image, video, sound).

Expected results: The practical result of the APAKT project will take teh form of computational tools for analyzing threats related to the propagation of illegal and sensitive content in cyberspace, using automatically created models of their classification, which are built using modern techniques of artificial intelligence and pattern recognition. The content classification will be built into a hotline system that reacts to child pornography and monitors the infrastructure employed to these attacks.

Keywords: child pornography, cyberspace security, classification, deep neural networks

[PR5] NCN Grant No. 505/00808/1031: **Using depth data for perspective correction of RGB descriptors**

Granting period: 28–03–2018 27–03–2020.

Principal investigator: Maciej Stefańczyk.

Aim of the project: In almost every service-robotics task, that requires cooperating with people or working in human environment, one of the key aspects is object recognition. In contrast to structured factory environments, where objects are placed in specific places (e.g. on conveyors) objects in house may be placed virtually anywhere. They can be also occluded (by other objects), distorted (e.g. creased box or bag) or deformed in anyway. Thus, robust object recognition methods are required. A lot of objects, that people cope with every day, contain distinct texture. For textured objects the existing recognition and localization methods rely on matching feature point sets of object's model to the points extracted from current scene. There is, however, crucial problem in this approach measurement distortions (scaling, rotation, perspective). Current algorithms cope with some of those problems, but there are no universal methods for distortion removal in object recognition task. The biggest problem is, undoubtedly, perspective distortion. In case, when measurements are supplemented with depth maps (aligned with color image) it is possible to calculate surface characteristics of the object around the keypoint. This information can then be used to apply perspective correction either to image itself or, if possible, inside feature descriptor algorithm. This additional step, in general, can be applied to any RGB descriptor, making them robust against perspective distortions and, as a result, making object detection and localization algorithms work better.

Expected results: Research in the project will start from recreation of already carried out feasibility studies (described in following section) and creation of initial algorithm version working with planar or nearly planar surfaces. Next, more surface types will be added, with spherical and cylindrical for example. For every surface types mathematical models of reprojection to camera frame and rejection of unstable points will be created. In parallel to those tasks, preparation of testing environment will be carried out. This includes preparation of simulator and gathering multiple test images (extension of object database). Last task is algorithms testing itself. This will be interleaved with theoretical and implementation works.

Keywords: computer vision, image processing, object recognition, feature points, descriptors, RGB-D

[PR6] NCN Grant No. 2017/25/N/ST7/00900: **Robot system design methodology based on a formal specification**

Granting period: 27–03–2018 26–03–2020.

Principal investigator: Maksym Figat.

Investigators: Maksym Figat, Dawid Seredyński, Cezary Zieliński.

Aim of the project: The basic objective of this research is to determine the general model of a robotic system. A robotic system is either a single or a multi-robot system optionally containing auxiliary devices. The model will be used to automatically generate code of the robotic controller. For this purpose we will extend the currently used specification methodology, which utilizes the concepts of an embodied agent, transition functions, behaviours and finite state machines (FSM). The research will lead to the creation of tools based on a model (Model Driven Engineering approach). They will be used to specify the model of the robotic system in a formal manner and to generate automatically the code of the robotic controller. For this purpose the

RSL language (Robot Specification Language) and its compiler will be developed. The correctness of the proposed generic model, usefulness and effectiveness of the RSL language and its compiler will be verified in practice. The proposed methodology and the proposed modelling tools will be verified on two robots: robot collecting table-tennis balls and two-handed robot with force and torque sensing and vision system.

The automatically generated code of the robotic controllers based on the model specified using the RSL language will be verified in a series of experiments using simulation and real hardware. Another objective of the proposed research is an attempt to confirm the hypothesis whether it is economically justified to automatically generate code of the whole robotic controller. Therefore, if the hypothesis will be not confirmed then the research will disclose which parts of the robotic system should be automaticallygenerated and which not.

Expected results: As a result of the proposed research the general methodology of designing robotic systems will be developed. Moreover tools facilitating the process of designing robotic systems will be created. The use of the RSL language and its compiler will facilitate the process of prototyping the robotic controllers. Possible changes in the robotic system structure or its activities will only require modifications to the model. Based on the model, the generated code will be devoid of any errors that may occur during manual code generation. The reliability of the generated code will depend only on the correctness of the developed model and developed transformations. However, the RSL compiler will ensure that the robotic model is valid. Additionally, the generated robotic controller code will be verified in a series of experiments in simulation and on real robots. The above mentioned robotic system development methodology will greatly improve the clarity of designed robotic systems, because they will use a specific and common architecture, consistent with the general concepts derived from robotics. Decomposition of the robotic system into collaborating agents and agent's subsystem introduces modularity. Thus, the relevant parts of the controller may be exchanged or reused in subsequent robotic systems. In addition, the proposed tools will visibly simplify and speed up the process of creating robotic controllers. This will increase the number of reliable robotic systems, which will facilitate the introduction of new solutions into the economy.

Keywords: Petri nets, robotic control system, methodology of designing robotic control system, DSL.

[PR7] NCN Grant SHENG 1 No. UMO-2018/30/Q/HS4/00764: **Advancing methodology of integrated decision-making support for sustainable development**

Granting period: 21–08–2019 20–08–2022.

Project in association with Systems Research Institute of the Polish Academy of Sciences and collaboration with the East China University of Science and Technology.

Principal investigator: Włodzimierz Ogryczak Investigator: Janusz Granat

Aim of the project: The overall project objective is to advance methods for science-based decision-making support in key problems of sustainable development, especially in trade-off analysis between attainable goals for economic efficiency, quality of environment, and human well-being. The overall objective is decomposed into the following Operational Objectives (OOs), each advancing methods in specific elements of Multi-Criteria Analysis (MCA) and verifying the developed methods through applications to real-life complex problems:

OO-1: Fairness. Build into the MCA methods minimizing inequalities in representing interests of diverse stakeholders. Verify the approach on multi-level supply chain in the China energy system model.

OO-2: Robust portfolios. Develop effective methods for handling uncertain factors of technological advancement and market prices. Verify the methods on technology portfolios with China's energy systems.

OO-3: Pareto set analysis. Develop methods for representing efficient-solutions' subsets fitting diverse preferences. Verify the methods on the China's model focused on decarbonization of energy-intensive industries.

OO-4: Post-interactive analysis. Develop methods for supporting users in effective selection of manageable subsets of Pareto-solutions that fit best diverse user preferences on attainable goals for competing criteria. Verify the approach on the China's energy system models.

Expected results: Rational decision-making, especially related to sustainable development, requires consistent consideration of societal and industrial problems that are increasingly complex and involve analysis of conflicts and synergies between diverse attainable goals for criteria measuring the development, such as various types costs and key elements of human well-being (e.g., availability of energy, clean water, as well as health impacts, quality of environment). Here, effective and efficient MCA methods are indispensable. Science, understood as organized knowledge, provides methods for integrating knowledge into model representations of relations between possible decisions and consequences of their implementation, as well as for knowledge creation through the model MCA. However, despite much progress in model-based decisionmaking support, some elements of the MCA still inadequately support problem analysis, which results in oversimplifications of the analysis, and thus hampers the effectiveness of the decision-making support. The project will, by filling the gaps in the MCA methods, not only provide effective methods for solving problems in sustainable development but also improve the basis for further development of science.

Keywords: sustainable development, decision-making support, multi-criteria analysis, fairness, uncertainty, robust.

[PR8] Warsaw University of Technology Centre for Priority Research Area Artificial Intelligence and Robotics Grant No. 504/04496/1031/45.010201: **Look & learn: Skill acquisition by a companion robot based on task demonstration**

Granting period: 10–07–2020 31–12–2021.

Principal investigator: Wojciech Szynkiewicz. Investigators from ICCE: Patryk Chaber, Paweł D. Domański, Wojciech Dudek, Maksym Figat, Włodzimierz Kasprzak, Maciej Ławryńczuk, Piotr Marusak, Robert Nebeluk, Piotr Pałka, Dawid Seredyński, Maciej Stefańczyk, Maciej Węgierek, Artur Wilkowski, Tomasz Winiarski, Cezary Zieliński.

Aim of the project: The aim of the project is to develop key technologies and methods necessary to construct a companion robot control system. A robot of this type must not only operate autonomously in home or office environments, but also interact socially with humans. The project is focused on the most important research issues related to robot programming by demonstration. The robot learns from examples of tasks performed by humans (look-and-learn). The way to delegate tasks to the robot must be easy to master by unskilled users.

Expected results: The result of the research work will be the structure of the robot control system that will contain modules responsible for: knowledge representation and processing, task planning and control of robot effectors and receptors. Knowledge

representation module will take into account perception, i.e. the results of processing of current observation of the environment. The methods developed in the project will be experimentally verified on real robots.

Keywords: robot companion, programming by demonstration, skills, control system

[PR9] Warsaw University of Technology Centre for Priority Research Area Artificial Intelligence and Robotics Grant No. 504/04496/1031/45.010601: **WUT Experts for Engineering and Scientific Projects (E2SP) at NICA**

Granting period: 07-07-2020 31-12-2021.

Principal investigator: Maciej Ławryńczuk. Investigators from ICCE: Patryk Chaber, Paweł D. Domański, Robert Nebeluk, Sebastian Plamowski, Tomasz Traczyk, Andrzej Wojtulewicz, Krzysztof Zarzycki.

Aim of the project: The purpose of the e-PIN project is to significantly develop the participation of WUT in the Nuclotron based Ion Collider fAcility (NICA) project being developed in Joint Institute for Nuclear Research (JINR), including participation in scientific research as part of both experiments, Monte-Carlo simulation of heavy-ion collisions, development of model predictions for physical processes and detector parameters, and a very wide contribution to design, construction, commissioning and use of all elements of the detection systems.

Expected results: Development of model predictions for nuclear collisions at NICA energies, and their registration process by MPD detector systems. Support of the monitoring of test equipment installation by EqDb (Equipment Database). SCADA WinCC SIEMENS for MPD. ECS Experiment Control System for NICA-MPD-PLATFORM. Support Systems for MPD. MCORD electronic muon subsystem. MPD thermal stabilisation.

Keywords: Joint Institute for Nuclear Research, Nuclotron-based Ion Collider fAcility, ion collision physics, measurement electronics, experiment support systems

[PR10] Scientific Council for the Discipline of Automatic Control, Electronics and Electrical Engineering Grant No. 504/04549/1031/43.020003: **Computationally efficient nonlinear model predictive control algorithms with alternative cost-functions**

Granting period: 22–07–2020 31–12–2021.

Principal investigator: Maciej Ławryńczuk. Investigator: Robert Nebeluk.

Aim of the project: The aim of the project is to develop computationally efficient nonlinear predictive control algorithms with alternative cost-functions. Currently, classical quadratic cost-functions are used, which do not always lead to good regulation quality. It is planned to use more complex cost-functions, e.g. a differential approximation of the absolute value function. Statistical indicators of control quality will also be considered. The rudimentary nonlinear optimisation problem will be transformed to a quadratic form, which shorten calculation time.

Expected results: An accepted article for an open access journal with a minimum score of 70 points, with the ultimate goal of 100+ points. An accepted paper in a foreign conference. Significant advancement of the PhD dissertation.

Keywords: Model predictive control, nonlinear models, optimisation

[PR11] Scientific Council for the Discipline of Automatic Control, Electronics and Electrical Engineering Grant No. 504/04549/1031/43.020001: **Flexible programmable matrix of model predictive controllers working in parallel in real time.**

Granting period: 22–07–2020 31–12–2021.

Principal investigator: Patryk Chaber. Investigator: Andrzej Wojtulewicz.

Aim of the project: The aim of this project is to design a novel software-hardware structure to control fast dynamic processes. This structure will allow for simultaneous use of Model Predictive Control for many processes of independent dynamics from each other.

Expected results: The designed matrix of controllers managed by the specialized subsystem will allow the user to utilize advanced control algorithms in a single embedded system, thus speeding up the process of design and development of industrial controllers.

Keywords: Field Programmable Gate Array, model predictive control. advanced control algorithms, matrix of controllers, embedded systems, industrial processes

[PR12] Scientific Council for the Discipline of Automatic Control, Electronics and Electrical Engineering Grant No. 504/04549/1031/43.020002: **Outliers in Control Engineering**

Granting period: 22–07–2020 31–12–2021.

Principal investigator: Paweł D. Domański. Investigators: Michał Falkowski, Dariusz Rocki, Maciej Ławryńczuk.

Aim of the project: Preparation of the multi-author monography entitled: "Outliers in Control Engineering - Fractional Calculus Perspectives", which will be published by De Gruyter.

Expected results: Proposed book includes a collection of contributions addressing different yet cohesive subjects, like dynamic modelling, classical control, advanced control, fractional calculus, statistical analytics focused on an ultimate goal: robust and outlier-proof analysis. All studied problems show that outliers play an important role and classical methods, in which outlier are not taken into account, do not give good results. Applications from different engineering areas are considered such as semiconductor process control and monitoring, MIMO peltier temperature control and health monitoring, networked control systems, and etc.

Keywords: outliers, fractional calculus, control engineering, performance assessment

[PR13] Rector's Grant No. 504440300031: **Development of educational and sports robot platforms**

Granting period: 19–06–2020 20–06–2021.

Principal investigator: Tomasz Winiarski. Investigators: Maciej Bogusz, Wojciech Dudek, Kamil Foryszewski, Daniel Giełdowski, Piotr Kostrzeński, Hubert Kowalski, Maciej Radzimirski, Dawid Seredyński, Michał Stolarz, Klaudia Stpiczyńska, Maciej Węgierek.

Aim of the project: The main goal of the project is to develop a research and teaching platform consisting of the group of MiniRyś robots, a modular board and a global location system. Part of the work has already been started, the main objectives of the grant are to improve the electronics and software of the MiniRyś robot and to verify the operation of its next version.

Expected results: The expected result: It is planned to conduct courses in the field of sports robotics, introducing students and new members of the robotic club to the basics of mobile robotics. For this purpose, Lego Mindstorms sets and the necessary construction parts will be purchased..

Keywords: robot, didactics

[PR14] Research agreement No. 501210300177 with PayEye Sp.z o.o.: **Evaluation of the PayEye payment terminal: drafting the testing protocol, overseeing the testing procedures, preparation of the report including the estimated parameters of the terminal**

Granting period: 01–10–2020 15–11–2020.

Principal investigator: Mateusz Trokielewicz. Investigators: Michał Hałoń, Ewelina Bartuzi.

Aim of the project: Evaluation of the quality of biometric templates and liveness detection algorithm (which decides whether a real, living eye is presented to the system) employing IR illumination techniques, as well as pupil tests. The evaluations are to be conducted on a group of 150-200 participants, in both artificial and natural lighting, both inside and outside of the buldings.

Expected results: A conclusion in the form of a report with selected PayEye payment terminal parameters estimates.

Keywords: payment terminal, biometrics, iris recognition

[PR15] Research agreement No. 501210102369 with Valmet Automation Sp. z o.o.: **Feasibiliy study document preparation aimed at the validation of the planned modernization of the Ammonia Production Installation at ZAK SA**

Granting period: 10–12–2020 23–01–2021.

Principal investigator: Paweł D. Domański.

Aim of the project: Preparation of the feasibility study for the modernization project, which aims at the improvement of the process steam distribution network including different pressure collectors. The project is dedicated for the Ammonia Production Line in the Zakłady Azotowe Kędzierzyn in Kędzierzyn Koźle.

[PR16] Research agreement No. 501210102377 with Multi-Aut Sp. z o.o.: **Development and implementation of algorithms for the distributor's pallet loading problem**

Granting period: 30–12–2020 30–09–2021.

Principal investigator from WUT: Krzysztof Pieńkosz. Investigators: Mariusz Kaleta, Krzysztof Kasprzak, Tomasz Śliwiński, Izabela Żółtowska

Aim of the project: The aim of the project is to develop algorithms for the distributor's pallet loading problem. They will be implemented and tested in the real life environment and applied to the robotic pallet loading system developed by Multi-Aut Sp. z o.o. company.

Expected results: A prototype planer application for the robotic system of pallet loading.

Keywords: distributor's pallet loading, 3D bin packing problem, combinatorial optimization

[PR17] Research agreements with Sąd Okręgowy w Warszawie, Sąd Okręgowy w Lublinie, Sąd Okręgowy w Rzeszowie and Sąd Okręgowy w Krakowie: **Expert opinions on the information systems and servises.**

Principal investigator: Andrzej Zalewski.

[PR18] Research agreement No. 5012103000012 with Zakłady Azotowe Puławy, Grupa Azoty S.A. **Design and implementation of the Advanced Process Control (APC) for ammonia production under sector NCBR program INNOCHEM.**

Granting period: 13–01–2017 31–03–2020.

Principal investigator from WUT: Paweł Domański.

Investigators from WUT: Maciej Ławryńczuk, Piotr Marusak.

Aim of the project: Comprehensive installation review has been performed. The analysis has been performed by expert team of all project stakeholders: technology owner, control system provider and research organization supporting the parties with scientific expertise. These activities have been done on-site and included historical data collection, review of plant documentation and P&ID drawings and meetings with the key personnel. The team has reviewed and analyzed all existing control logics and associated tuning parameters together with the site instrumentation (sensors and actuators). Next the team has participated in the process of the APC implementation as the advisory body.

Keywords: Control Performance Assessment, ammonia production, APC, MPC. Research agreements with Sąd Okręgowy w Warszawie, Sąd Okręgowy w Rzeszowie, Sąd Okręgowy w Krakowie and Sąd Okręgowy w Lublinie: Expert opinionson the information systems and services.

[PR19] Research agreement No. 501210102070 with Multi-Aut Sp. z o.o.: **Preparation of the MultiPallet IT system for optimization and preparation of palletizing schemes for the palletizing unit**

Granting period: 17.09.2019 – 25.05.2020.

Principal investigator from WUT: Tomasz Winiarski

The work will include preparation and discussion of requirements for the system to be developed. In the next stage, a prototype system will be created, whose operation will be analysed in the last stage of work.

5 Degrees Awarded

5.1 D.Sc. Degrees

Michał Karpowicz
Thesis defended on March 30, 2020

Piotr Marusak
Thesis defended on Sept. 29, 2020

5.2 Ph.D. Degrees

Advisor: **Prof. Ewa Niewiadomska-Szynkiewicz**

Mateusz Krzysztoń
Wykrywanie i śledzenie chmury gazów ciężkich z wykorzystaniem mobilnych sieci ad hoc
Thesis defended on Sept. 29, 2020

Advisor: **Prof. Maciej Ławryńczuk**

Andrzej Wojtulewicz
Projektowanie systemów sterujących wykorzystujących algorytmy regulacji predykcyjnej i struktury FPGA
Thesis defended on Nov. 17, 2020, with honors

5.3 M.Sc. Degrees

Advisor: **Piotr Arabas:**

M. Starosta
Analiza wpływu czynników zewnętrznych na aktywność użytkowników serwisów społecznościowych
Degree awarded on October 2020

Advisor: **Piotr Bilski**

B. Stelmaszuk
System inteligentny do rozpoznawania obiektów na zdjęciach
Degree awarded on October 2020

Advisor: **Patryk Chaber**

P. Barański
Układ sterowania służący do pozycjonowania wstęgi materiału w maszynie
Degree awarded on October 2020

Advisor: **Paweł Cichosz (II)**

M.Moskała (OKNO)
Predykcja zagrożenia przestępczością w obszarach miejskich z wykorzystaniem charak-
terystyki miejsca i czasu
Degree awarded on March 2020

Advisor: **Paweł Domański**

K. Kulas
Środowisko do wielokryterialnej analizy układów sterowania
Degree awarded on July 2020

M. Okoński
Design of a robust oscillation detection and characterization procedure
Degree awarded on July 2020

A.Wasiak
Porównanie wybranych modeli szeregów czasowych do prognozowania zjawisk finansowych
Degree awarded on October 2020

Ł. Pawełkiewicz
Nieliniowa analiza danych meteorologicznych
Degree awarded on October 2020

Advisor: **Grzegorz Galiński (IRE)**

M. Czelij
Algorytmy detekcji twarzy w obrazie i ich implementacja w systemach wbudowanych
Degree awarded on October 2020

Advisor: **Piotr Garbat (IMIO)**

K. Czerski
Realizacja algorytmu śledzenia ruchu gałek ocznych w hełmie wirtualnej rzeczywistości
Degree awarded on October 2020

Advisor: **Mariusz Kaleta**

K. Stępień (OKNO)
Architektura ESB na przykładzie wybranej platformy integracyjnej - teoria kontra rzeczywis-
tość
Degree awarded on March 2020

P. Wróbel
System ładowania pojazdów elektrycznych w oparciu o technologię blockchain
Degree awarded on March 2020

W. Cabaj (OKNO)
Korzyści wynikające z wdrożeń RPA w wybranych procesach biznesowych
Degree awarded on March 2020

Advisor: **Mariusz Kamola**

J. Kolis
Klasyfikacja użytkowników serwera WWW
Degree awarded on March 2020

M. Marzec
Badanie związku pomiędzy wydźwiękiem emocjonalnym tekstów piosenek a cechami statystycznymi melodii
Degree awarded on March 2020

F. Lewczak
Klasyfikacja tekstów ironicznych
Degree awarded on March 2020

H. Święciński
Odwzorowanie pojęć Słowosieci w taksonomię Linked Open Data
Degree awarded on March 2020

Advisor: **Andrzej Karbowski**

I. Ruksha
Decomposition methods for network optimization problem of simultaneous routing and bandwidth allocation
Degree awarded on March 2020

M. Kabaciński
Parallel implementations of the shortest path finding algorithms
Degree awarded on October 2020

Advisor: **Włodzimierz Kasprzak**

J. Kanturski (OKNO)
Efektywne modelowanie i rozpoznawanie obiektów w sekwencji wideo
Degree awarded on March 2020

M. Bogucki
Modelowanie i wyszukiwanie obiektów w obrazach z wykorzystaniem sieci neuronowych
Degree awarded on October 2020

Advisor: **Przemysław Korpas (II)**

M. Gogół (OKNO)
Porównanie technologii wytwarzania oprogramowania "Low-Code" oraz tradycyjnej na przykładzie aplikacji webowej z elementami "IoT"
Degree awarded on October 2020

Advisor: **Adam Kozakiewicz**

M. Perciński
Analiza powierzchni ataku systemów samochodowych
Degree awarded on March 2020

Advisor: **Tomasz Kruk**

D. Kuna-Broniowski
System ksiąg wieczystych oparty o drzewa Merkla
Degree awarded on March 2020

Advisor: **Adam Krzemienowski**

B. Mikołajczyk
Wielokryterialny wybór koszyka produktów żywnościowych
Degree awarded on March 2020

Ł. Wysocki (OKNO)
Konstrukcja portfeli odpornych z ryzykiem mierzonym wskaźnikiem Omega
Degree awarded on October 2020

W. Sobczyk
System wspomagania gry w zakładach bukmacherskich
Degree awarded on October 2020

Advisor: **Maciej Ławryńczuk**

I. Okulska
Otwórz okno, zamknij drzwi: koncepcja wielowarstwowego systemu regulacji komfortu cieplnego uwzględniająca komunikację z użytkownikiem nieprofesjonalnym
Degree awarded on February 2020

P. Tymiński
Zaawansowane algorytmy sterowania 3-osiowym stabilizatorem do kamer
Degree awarded on March 2020

M. Kędzielski
Opracowanie oprogramowania wspierającego pracę audytora systemów informatycznych
Degree awarded on March 2020

J. Pankiewicz
Granice stosowalności algorytmów nieliniowej regulacji predykcyjnej z linearyzacją
Degree awarded on March 2020 (with honors)

K. Zarzycki
Konstrukcja nieliniowego wielowymiarowego stanowiska laboratoryjnego "kulka na płaszczyźnie" oraz projektowanie algorytmów regulacji procesu
Degree awarded on March 2020

Advisor: **Piotr Marusak**

M. Janus
Automatyzacja procesu zgrzewania elementów wentylacyjnych
Degree awarded on March 2020

Advisor: **Ewa Niewiadomska- Szynkiewicz**

K. Szczepaniak
System głosowania elektronicznego w technologii Blockchain
Degree awarded on March 2020

Advisor: **Andrzej Pacut**

M. Misiurewicz
System weryfikacji mówcy niezależny od treści dla języka polskiego. Rozwiązanie end-to-end
Degree awarded on July 2020

Advisor: **Piotr Pałka**

C.Sanecki (OKNO)
Opracowanie modeli matematycznych do podejmowania decyzji dla dostawców materiałów budowlanych
Degree awarded on June 2020

G. Szczepanik
Agentowy przestrzenny model symulacyjny do analiz carsharingu w Smart City
Degree awarded on June 2020

M. Wiraszka
Skalowalne oraz zautomatyzowane systemy Internetu Rzeczy bazujące na usługach chmurowych
Degree awarded on October 2020 (with honors)

Advisor: **Krzysztof Pieńkosz**

A. Prasał
Wyznaczanie krótkich struktur połączeń w sieciach teleinformatycznych
Degree awarded on October 2020

J. Dróżdż
Wyznaczanie połączeń w sieciach teleinformatycznych z jak najmniejszą liczbą ścieżek
Degree awarded on October 2020

Advisor: **Sebastian Plamowski**

B. Seferyńska
Algorytmy automatycznej adaptacji modelu w regulatorze predykcyjnym w zastosowaniu do obiektu laboratoryjnego
Degree awarded on March 2020

M. Pawliński
Modelowanie, regulacja i optymalizacja w projektowaniu warstwowej struktury sterowania wielowymiarowym stanowiskiem laboratoryjnym
Degree awarded on October 2020

Advisor: **Andrzej Ratkowski**

T. Zwornicki
Modułowy symulator na potrzeby instalacji IoT
Degree awarded on March 2020

B. Lorenc (OKNO)
Stacja przewidywania pogody wsparta metodami sztucznej inteligencji jako przykład systemu opartego na infrastrukturze IoT z zastosowaniem Architektury Lambda
Degree awarded on November 2020

J. Wnuk
Rozwiązanie problemu Ciągłej Integracji i Ciągłego Wdrażania systemów w architekturze mikroserwisowej
Degree awarded on November 2020

Advisor: **Ryszard Romaniuk (ISE)**

Sz. Michalski
Star-tracker program for small satellites
Degree awarded on March 2020

Advisor: **Janusz Rzeszut (II)**

M. Waszak
Algorytmy sterowania silnikami krokowymi
Degree awarded on March 2020

Advisor: **Piotr Sapiecha (TELE)**

A.Mizerski (OKNO)
Bezpieczeństwo poczty elektronicznej
Degree awarded on October 2020

Advisor: **Marcin Szlenk**

T. Osoba
Edytor modeli dla języka ConML
Degree awarded on March 2020

T. Paczos
Automatyczna generacja kodu na podstawie modeli w języku IFML
Degree awarded on November 2020

Advisor: **Wojciech Szynkiewicz**

A. Brzozowski
Efektywna obliczeniowo metoda planowania ścieżki ruchu robota mobilnego z ograniczeniami kinematycznymi
Degree awarded on October 2020

Advisor: **Tomasz Śliwiński**

B. Froń (OKNO)
Optymalizacja przewozu towarów z uwzględnieniem okien czasowych
Degree awarded on June 2020

T. Dudzik (OKNO)
Algorytm genetyczny i algorytm VNS w problemie układania planu zajęć
Degree awarded on October 2020

Advisor: **Tomasz Trzciński (II)**

K. Palczewski
Breast cancer diagnosis from mammography screenings employing convolutional neural networks
Degree awarded on July 2020

M. Pęśko
Zmiana stylu wideo z wykorzystaniem głębokich sieci neuronowych
Degree awarded on October 2020

Advisor: **Artur Wilkowski**

M. Burzyński
Zastosowanie metod widzenia komputerowego w realizacji asystenta kierowcy samochodowego
Degree awarded on October 2020 (with honors)

Advisor: **Tomasz Winiarski**

Ł. Zieliński
Robot mobilny TIAGo wykorzystujący planowanie symboliczne przy wspieraniu osób starszych
Degree awarded on March 2020

Sz. Jarocki
Rozszerzenie prawa sterowania robota usługowego Velma w odniesieniu do manipulacji obiektami
Degree awarded on October 2020 (with honors)

Advisor: **Izabela Żółtowska**

M. Ignatowski
Moduł planowania produkcji dla Tobzamer S.C.
Degree awarded on March 2020

W. Kołodziejczyk (OKNO)
Bieżąca optymalizacja zakupu energii elektrycznej dla klastra z magazynem energii przy wykorzystaniu głębokiego uczenia ze wzmocnieniem
Degree awarded on March 2020

M. Trochimiak
System rekomendacji dla użytkowników internetowych z wykorzystaniem modelu wyborów dyskretnych
Degree awarded on March 2020

D. Młynarek
Projekt niskokosztowego Programowalnego Sterownika Logicznego opartego na płycie mikroprocesorowej Arduino
Degree awarded on June 2020

K. Bielińska (OKNO)
Wybór i ocena detalistów przez producentów w oparciu o przedziałową metodę punktu odniesienia
Degree awarded on October 2020

M. Klepacz
Model wspomagania doboru architektury dla globalnej usługi opartej na chmurze obliczeniowej
Degree awarded on October 2020

5.4   B.Sc. Degrees

Advisor: **Piotr Arabas**

Sz. Kozłowski
Aplikacja mobilna rekomendująca programy telewizyjne
Degree awarded on February 2020

M. Dudek
Aplikacja wspomagająca wybór paczkomatu
Degree awarded on July 2020

Advisor: **Patryk Chaber**

K. Bednarski
Minimalizacja zużycia energii w systemie do oczyszczania powietrza
Degree awarded on February 2020

M. Kuchenbecker
Automatyczny tuner gitarowy w oparciu o Dyskretną Transformatę Fouriera
Degree awarded on February 2020

M. Paluch
Implementacja regulatora DMC w wersji numerycznej w języku funkcyjnym
Degree awarded on October 2020

Advisor: **Paweł Domański**

K. Kaczmarek
Robustness analysis of the minimum variance control quality measure
Degree awarded on July 2020

B. Kurpiewski
Ocena efektywności sportowca na podstawie danych statystycznych
Degree awarded on September 2020

Advisor: **Maksym Figat**

P. Chachuła
Edytor graficzny do definiowania funkcji przejścia w podsystemach agenta upostaciowionego
Degree awarded on February 2020

Advisor: **Janusz Granat**

S. Karpov
Driver style evaluation based on localization data
Degree awarded on February 2020

K. Kasprzak
Analiza wielokryterialna danych z wykorzystaniem dostępnych informacji w OpenStreetMap
Degree awarded on February 2020

Advisor: **Jerzy Gustowski**

M. Konieczka
Zestaw symulacyjny obiektów sterowania binarnego
Degree awarded on February 2020 (with honors)

A.Poturała
Zbadanie możliwości programu do symulacji stanowisk modelu linii produkcyjnej
Degree awarded on February 2020 (with honors)

K. Seweryn
Oprogramowanie PLC stanowiska laboratoryjnego - buforowanie i rozdział transportowanych detali
Degree awarded on February 2020

I. Drozdowska
System zarządzania rezerwacjami w punktach gastronomicznych
Degree awarded on February 2020

P. Gajewski
Automatyzacja inżynierii oprogramowania sterowników PLC dla potrzeb Przemysłu 4.0
Degree awarded on February 2020

A. Lobach
Prezentacja danych procesowych w rozwiązaniach chmurowych Microsoft Azure
Degree awarded on February 2020

W. Drożdżowski
Aplikacja do zwiedzania miasta
Degree awarded on July 2020

Advisor: **Mariusz Kaleta**

S. Kamoda
System wspierający prowadzenie zdalnej inspekcji
Degree awarded on February 2020

D. Sulgostowska
Aplikacja mobilna dla systemu Android wspierająca trening kreatywności
Degree awarded on February 2020

Advisor: **Mariusz Kamola**

G. Kuduk
Implementacja systemu wnioskującego w systemie operacyjnym Android
Degree awarded on February 2020

T. Słuszniak
Platforma informacyjnej współpracy ogólnowydziałowej - aplikacja mobilna
Degree awarded on February 2020

Z. Dąbrowska
Narzędzie wspomagające profile biznesowe w sieci społecznościowej Instagram
Degree awarded on September 2020

Advisor: **Włodzimierz Kasprzak**

I. Osetek
Niestandardowe rozpoznawanie komend mowy
Degree awarded on February 2020

Advisor: **Jakub Koperwas (II)**

M. Bajena
Analiza statystyczna, porównawcza i wizualizacja korpusów tekstowych
Degree awarded on October 2020

Advisor: **Adam Kozakiewicz**

K. Cąderek
Fingerprinting ataków brute-force na protokół SSH
Degree awarded on September 2020

Advisor: **Tomasz Kruk**

J. Wesołowski
Laboratorium systemów operacyjnych w środowisku systemu Linux
Degree awarded on February 2020

Advisor: **Adam Krzemienowski**

Z. Kaczyński
System wieloagentowy do badania wpływu kreacji pieniądza na cykle koniunkturalne w architekturze CUDA
Degree awarded on September 2020

Ł. Smogorzewski
Równoważenie portfela inwestycyjnego z uwzględnieniem ograniczeń rzeczywistych
Degree awarded on September 2020

Advisor: **Maciej Ławryńczuk**

P. Roszkowski
Porównanie efektywności algorytmów DMC oraz GPC w zastosowaniu do regulacji wielowymiarowego procesu z zakłóceniami
Degree awarded on February 2020

R. Wojtaś
Internetowy symulator algorytmów regulacji predykcyjnej
Degree awarded on February 2020

J. Niewiński
Regulacja predykcyjna procesów nieliniowych z wykorzystaniem sieci Elmana
Degree awarded on July 2020

Advisor: **Arkadiusz Łuczyk (IMIO)**

M. Bedliński
Asynchroniczna obsługa zadań obliczeniowych
Degree awarded on September 2020

Advisor: **Piotr Marusak**

P. Żakieta
Rozmyte sterowanie predykcyjne obiektu nieliniowego w warunkach ograniczeń
Degree awarded on February 2020

Advisor: **Ewa Niewiadomska-Szynkiewicz**

K. Guliński
System do monitorowania środowiska wykorzystujący stacjonarne i mobilne czujniki
Degree awarded on February 2020

P. Ducki
Rejestr nieruchomości w technologii blockchain
Degree awarded on October 2020

T. Sachanowski
Integracja narzędzi do analizy danych w krystalografii rentgenowskiej ze środowiskiem Jupyter
Degree awarded on October 2020

Advisor: **Piotr Pałka**

M. Fijałkowski
Angażowanie członków społeczności w partycypację publiczną z wykorzystaniem mechanizmów grywalizacji
Degree awarded on February 2020

K. Mandas
Projekt i implementacja aplikacji użytkowej wspierającej realizację aktywności grupy osób
Degree awarded on October 2020

Advisor: **Krzysztof Pieńkosz**

K. Grabowski
Analiza algorytmów wyznaczania ścieżek przepływu w sieciach
Degree awarded on February 2020

D. Stalewski
Algorytmy heurystyczne wspomagania planowania dystrybucji towarów
Degree awarded on September 2020

Advisor: **Sebastian Plamowski**

M. Dolicher
Realizacja projektów automatyki przemysłowej z wykorzystaniem High Performance HMI i metodyk zwinnych
Degree awarded on February 2020

M. Grochowina
Opracowanie systemu detekcji i sygnalizacji zagrożeń na wybranym obiekcie przemysłowym
Degree awarded on February 2020

J. Zgorzelski
Modernizacja systemów BMS wraz z analizą HAZOP w przemyśle na przykładzie kotła
Degree awarded on February 2020

Advisor: **Andrzej Ratkowski**

P. Miśkiewicz
Aplikacja internetowa do wyszukiwania i tworzenia wydarzeń sesji RPG
Degree awarded on February 2020

M. Osowiecki
Rozszerzenie frameworka Spring Boot do obsługi języka Jolie
Degree awarded on February 2020

D. Sitnik
Aplikacja mobilna ułatwiająca spontaniczne spotkania
Degree awarded on February 2020

E. Sokół
Projekt i implementacja modułu Interpretera ekosystemu analizy danych dla Internet of Things
Degree awarded on September 2020

A. Grudkowski
Aplikacja interfejsu użytkownika do systemu algorytmów analitycznych dla urządzeń IoT
Degree awarded on November 2020

Advisor: **Michał Rudowski (II)**

S. Kulesza
Badanie własności systemu Oracle Database 18c Express Edition
Degree awarded on February 2020

Advisor: **Maciej Stefańczyk**

K. Chachuła
Wykorzystanie kamery sferycznej w symulacji robotów usługowych
Degree awarded on February 2020 (with honors)

M.Wilczyński
Wykrywanie i śledzenie zagrożeń w nagraniach z wideorejestratorów samochodowych
Degree awarded on February 2020

Advisor: **Marcin Szlenk**

P. Czytański
System strumieniowego odtwarzania muzyki w technologii .NET
Degree awarded on February 2020

Advisor: **Zbigniew Szymański (II)**

P. Misztal
Skalowany, uniwersalny program monitorujący pracę urządzeń fabryki przy użyciu Microsoft Azure
Degree awarded on July 2020

Advisor: **Wojciech Szynkiewicz**

S. Borkowski
System planowania oraz realizacji trajektorii lotu czterowirnikowca
Degree awarded on February 2020

M. Skrzypkowski
System autonomicznej nawigacji manipulatora mobilnego Velma
Degree awarded on September 2020

G. Fijałkowski
System symbolicznego planowania zadań dla robota Velma
Degree awarded on October 2020

Advisor: **Tomasz Śliwiński**

M. Prewysz-Kwinto
System planowania i zarządzania spotkaniami autorskimi
Degree awarded on February 2020

H. Ziarek
Symulator gry rynkowej w środowisku Oracle
Degree awarded on October 2020

Advisor: **Tomasz Winiarski**

R. Gryta
Symulacyjne badanie wpływu sposobu mocowania kiści robota Velma na wykonywanie przez niego przykładowych zadań
Degree awarded on February 2020

J. Sikora
Integracja części manipulacyjnej i bazy mobilnej robota Velma na potrzeby symulacji
Degree awarded on February 2020

M. Stolarz
Robot MiniRyś śledzący linię z wykorzystaniem systemu wizyjnego
Degree awarded on July 2020

Advisor: **Andrzej Wojtulewicz**

K. Borowski
Opracowanie i implementacja kinematyki dla fizycznego modelu robota przemysłowego
Degree awarded on September 2020

K. Wiłnicki
Opracowanie wielokanałowego systemu wizualizacji dźwięku w oparciu o mikrokontroler oraz algorytm szybkiej transformaty Fouriera
Degree awarded on September 2020

Advisor: **Andrzej Zalewski**

S. Karpa
Projekt i prototyp systemu zbierania wiedzy architektonicznej dla firmy software'owej
Degree awarded on February 2020

Advisor: **Paweł Zawistowski (II)**

J. Ambroziak
Aplikacja do testowania odporności modeli klasyfikacyjnych na ataki z użyciem złośliwych danych
Degree awarded on November 2020

Advisor: **Izabela Żółtowska**

P. Ogrodnik
Opracowanie narzędzia wspierającego ocenianie zespołowych prac studentów
Degree awarded on February 2020

M. Stawiarski
Aplikacja mobilna wspomagająca kierowców w szukaniu wolnych miejsc parkingowych
Degree awarded on February 2020

A. Nuszel
Opracowanie i implementacja aplikacji do wspomagania działań promocyjnych pubów
Degree awarded on September 2020

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