

Institute of Control and Computation Engineering

2019 Annual Report



Warsaw University of Technology
Faculty of Electronics and Information Technology
Institute of Control and Computation Engineering
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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.

The Biometrics and Machine Learning Group has been involved in the Marie Skłodowska-Curie European Training Network (Horizon 2020) project *enhAnced Mobile BiomEtRics (AMBER)*. The partners of the project are: 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 focuses on addressing a range of current issues facing biometric solutions on mobile devices.

The Optimization and Decision Support Group has recently obtained a research grant “Advancing methodology of integrated decision-making support for sustainable development” within the National Science Centre (NCN) programme SHENG which is the new funding opportunity for Polish-Chinese research projects in collaboration with the National Natural Science Foundation of China (NSFC). The project will be supervised by Prof. Włodzimierz Ogryczak. A consortium includes WUT (project leader) and Systems Research Institute of Polish Academy of Science (IBS PAN) and works jointly with the East China University of Science and Technology (ECUST).

The Complex Systems Group has been involved in the National Science Centre grant Energy-aware computer system for HPC computing. This research project, led by Prof. Ewa Niewiadomska-Szynkiewicz, addresses the vital problem of energy efficient high performance distributed and parallel computing. Its objective is to acquire new knowledge on the stochastic dynamics of data processing in High Performance Computing (HPC) systems and to develop adaptive resource management algorithms which efficiently exploit new power control capabilities of contemporary computer hardware. The research objective is to provide contributions to development of future generations of computing and operating systems. Furthermore, the Complex Systems Group with the Machine Perception Group and the Robot Programming Group have been involved in the National Centre for Research and Development project National cybersecurity platform (NPC). The project led by Prof.

Ewa Niewiadomska-Szynkiewicz is coordinated by NASK-PIB while involving also National Institute of Telecommunications and National Centre for Nuclear Research. 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.

Research is a vital part of our activities, directly affecting both the Institute's recognition in Poland and abroad, and the quality of teaching. Description of research programs conducted by the faculty of the Institute can be found in this report. I express my sincere appreciation to the faculty and staff of the Institute for their efforts and contributions to our achievements in teaching and research.

It is my pleasure to congratulate Prof. Piotr Tatjewski who was given the Warsaw University of Technology Rector's Award for Lifetime Achievements. I would like to compliment Dr. Tomasz Kruk who won the Best Lecturer students' award. I also congratulate Dr. Piotr Pałka on being awarded the Medal of the Commission of National Education and MSc. Włodzimierz Macewicz on being awarded the Gold Medal for Long Service. I congratulate Dr. Patryk Chaber and Dr. Mateusz Trokielewicz who have obtained their PhD degree with honors in 2018 and 2019, respectively.

I would like to thank Prof. Krzysztof Malinowski, who retired in February 2019, for his long and fruitful work for the Institute. Prof. Malinowski was a director of the Institute of Control and Computation Engineering in years 1984–1996 and the Dean of the Faculty of Engineering and Information Technology in years 1996–1999. He was a Member of the Polish Academy of Sciences (Corresponding Member 1998–2016, Full Member 2016–), Chairman of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN) (2007–2014) and Chair of the Council of Provost, Division IV: Engineering Science, Polish Academy of Sciences (2015–2018). Prof. Malinowski has supervised as many as 21 PhD students, out of whom 5 have received DSc degrees and 3 have become professors.

I deeply regret due to the passing of Prof. Krzysztof Sacha, leader of the Software Engineering Group. He served as Auditor evaluating software projects for public organizations (2002–2005), Advisor to the President of Social Insurance Institution (2005–2009). Member of the Council of the National Centre for Research and Development (2010–2014). Prof. Sacha will be greatly missed by his students and his colleagues in the Institute.

Włodzimierz Ogryczak

Spis treści

1	General Information	7
1.1	Directors	7
1.2	Organization of the Institute	7
1.3	Statistical Data	11
2	Faculty and Staff	13
2.1	Professors Emeriti	13
2.2	Senior Faculty	17
2.3	Supporting Faculty and Staff	31
2.4	Ph.D. Students	32
2.5	Administrative and Technical Staff	35
3	Teaching Activities – Academic Year 2018/2019	36
3.1	Undergraduate and Graduate Studies	36
3.2	Extramural Graduate Studies	39
3.3	Graduate Distance Learning	39
4	Projects	40
5	Degrees Awarded	48
5.1	Ph.D. Degrees	48
5.2	M.Sc. Degrees	48
5.3	B.Sc. Degrees	55
6	Publications	62
6.1	Scientific or Technical Books	62
6.2	Scientific and Technical Papers in Books and Conference Proceedings	62
6.3	Scientific and Technical Papers in Journals	63

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1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2019.

1.1 Directors

Professor Włodzimierz Ogryczak, Director
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
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:	W. Dudek, M. Figat, K. Gabor-Sitkowska, W. Gutfeter, M. Hałoń, J. Karwowski, M. Krzysztoń, P. Piwowarski, D. Seredyński, E. Bartuzi, M. Klimczak, 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, M. Klimczak, 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)

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 multi-modal human-machine interfaces, automatic surveillance 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
Professors:	M. Ławryńczuk P. Tatjewski
Assistant Professors:	P. Chaber, P. Domański, P. Marusak, S. Plamowski, A. Zalewski
Assistant:	K. Borowa, S. Kijas, R. Nebeluk, A. Wojtulewicz
Senior Lecturers:	J. Gustowski, A. Ratkowski, M. Szlenk
Senior Engineer:	W. Macewicz
Ph.D. Students:	K. Czerwiński, 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. Czerwiński)

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, B. Kozłowski, P. Pałka, K. Pieńkosz, A. Stachurski, T. Śliwiński, I. Żółtowska
Assistant:	A. Manujło
Senior Lecturers:	J. Sobczyk, M. Kaleta, A. Krzemienowski
Ph.D. Students:	A. Mościcka, 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)

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, A. Mościcka, 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	2017 persons	2018 persons	2019 persons
Academic Staff	41(+2)	44(+2)	47(+2)
by titles/degrees			
Professors	9	8	7
D.Sc.-s	6	7	7
Ph.D.-s	17(+2)	19(+2)	21(+2)
M.Sc.-s	7	8	10
Others			2
by positions			
Professors	10	9	8
Readers	1	1	1
Assistant Professors	21(+2)	19(+2)	21(+2)
Senior Lecturers	3	6	6
Assistants	6	9	11
Ph.D. Students	19	28	28
Technical Staff	4	3	2
Administrative Staff	7	7	7

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

ACTIVITIES	2017	2018	2019
Teaching activities			
standard teaching potential, hours	9 494,20	9 785,01	9 980,01
# hours taught	14 962,00	14 097,90	14 043,70
Degrees awarded			
Professor	1	0	0
D.Sc	0	0	0
Ph.D.	1	1	2
M.Sc.	51	30	59
B.Sc.	37	69	59
Research projects			
granted by WUT	7	5	5
granted by State institutions	5	5	5
granted by international institutions	2	2	4
other	6	5	3
Sci.-Tech. publications			
monographs (authored or edited)	1	2	1
chapters in books and proceedings	29	26	18
papers in journals	30	22	34
Reports, abstracts and other papers	7	1	0
Conferences			
participation (# of conferences)	14	28	27
participation (# of part. from ICCE)	27	65	38

RESOURCES	2017	2018	2019
Space (sq.m.)			
laboratories	644	644	644
library + seminar room	182	182	182
faculty offices	821	821	821
Computers			
personal computers	172	221	234
Library resources			
books	3 154	3 176	3 188
booklets	2 959	2 959	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

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 Division, 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

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**

maksym.figat@pw.edu.pl

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

**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

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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)

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

With WUT since 2014

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

Włodzimierz Kasprzak Professor

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

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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

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

With WUT since 2008.

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

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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)

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M.Sc. 2004 from WUT.

With WUT since 2010.

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

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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)

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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

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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 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

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M.Sc. 2019 from WUT

With WUT since 2019

Interests: Modelling, control algorithms, optimization.

Jalil Khiarak Nourmohammadi Assistant

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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)

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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.

Expert 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 of Science system of PAN

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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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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

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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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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 Assistant Professor (until Oct. 2018), Senior Lecturer (since Nov. 2018)

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

With WUT since 2009.

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

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M.Sc. 2012 from WUT.

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Interests: grasp planning, manipulation planning**Jerzy Sobczyk** Senior Lecturer**Operations and Systems Research Division, Optimization and Decision Support Group****room 519A, tel. 22 234 7863**

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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**Operations and Systems Research Division, Optimization and Decision Support Group****room 553, tel. 22 234 7640**

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

Maciej Stefańczyk Assistant

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M.Sc. 2011

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Interests: Computer vision, computer graphics.

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

With WUT since 2005.

Interests: Software modelling and verification, formal methods in software engineering.

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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

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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)

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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, Vice-Chairman of the Control Committee of POLSPAR (2010–2019), Vice-chairman of the Scientific Council of Systems Research Institute of Polish Academy of Sciences (2011–2018). Member of the Polish Central Commission 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

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

room 516, tel. 22 234 7950

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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 CO₂ 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)

System Control Division, Biometric and Machine Learning Group

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

Artur Wilkowski Assistant Professor

Systems Control Division, Machine Perception Group

room 564

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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

Systems Control Division, Robot Programming Group

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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
Control and Software Engineering Division, Control Engineering Group
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M.Sc. 2014 from WUT

With WUT since 2016

Interests: Control theory, FPGA, microcontroller.

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

Cezary Zieliński Professor (Leader of the Group, Head of Division)
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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–).

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

Izabela Żółtowska Assistant Professor

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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

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M.Sc. from WUT.

With WUT since 1983.

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

Sylwia Piskorska R&D Specialist

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M.Sc. 2002 from Technical University of Gdańsk.

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2.4 Ph.D. Students

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Mariusz Drabecki Ph.D. Student

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Supervisor: Eugeniusz Toczyłowski

Jarosław Karwowski Ph.D. Student

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Supervisor: Andrzej Pacut

Paweł Piwowarski Ph.D. Student

Systems Control Division, Machine Perception Group
Supervisor: Włodzimierz Kasprzak

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Maciej Węgierek Ph.D. Student

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Supervisor: Włodzimierz Ogryczak

2.5 Administrative and Technical Staff

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M.Sc. 2002 from Warsaw School of Management and Marketing.

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M.Sc. 2007 from the M.Skłodowska-Curie Warsaw Academy

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baccalaureate 2005 from Leon Kozmiński Academy of Entrepreneurship and Management

Alicja Trojanowska Secretary, Student affairs.

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baccalaureate 2012 from WUT.

Beata Woźniak Manager, Administration.

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M.Sc. 1993 from Warsaw University.

3 Teaching Activities – Academic Year 2018/2019

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)	sem 3
Automation and Engineering Measurements in Industry	AP	1 - 1 -	P. Domański (fall)	
Optimization Algorithms and Methods	AMO	2 - - 2	A.Stachurski (fall)	
Anatomy of Robots	ANRO	1 - 2 -	T.Winiarski (spring)	
Artificial Intelligence	EAI	2 - - -	W.Kasprzak (spring)	
Systems Architecture and Integration	AIS	2 - 1 -	A.Ratkowski (spring/fall)	
Automation and Robotics Equipment	APA	2 - 1 -	T.Winiarski (spring/fall)	
Basics In Automatics	PODA	2 - 1 -	P.Marusak (spring) M.Ławryńczuk (fall)	
Biometric Identity Verification	BIT	2 - 1 -	A.Pacut (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 (fall)	sem. 2
Fundamentals of Operation Research	POBO	2 - 1 -	K.Pieńkosz (spring) E.Toczyłowski (fall)	sem. 4
Fundamentals of Parallel Computation	PORR	2 - - 2	E.Niewiadomska-Szynkiewicz (fall)	
Fundamentals of Programming	PRI	2 1 2 -	T.Śliwiński (spring)	sem. 1
Image and Speech Recognition	EIASR	2 1 - 1	W.Kasprzak (spring/fall)	
Information Project Management	ZPI	2 - - 1	K.Pieńkosz (spring/fall)	
Intelligent Robotic System	ISR	2 - 1 -	C.Zieliński (fall)	
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/fall)	
Modeling and Control of Manipulators	EMOMA	3 1 - -	C.Zieliński (fall)	
Modelling and Identyfication	MODI	2 1 - 1	P.Domański (spring)	
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)	

Course Title	Course code	Hours per week	Lecturer	Notes
Networks Systems Control	SST	2 - - 1	M.Karpowicz (spring)	
Object Programming	PROI	2 - 2 -	T.Śliwiński (fall)	
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 -	E.Toczyłowski I.Żółtowska(spring)	
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 Specyfication 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)	
Microprocessor control systems	SMS	2 - 2 -	M.Ławryńczuk (spring/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)	
Artificial Intelligence Methods	MSI	2 - 1	W.Kasprzak, A.Pacut (spring)	
Robot Control and Simulation	STERO	- 2 2	T.Winiarski (fall)	
Automation and Engineering Measurements	APP	1 - 1 -	P.Domański (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	A.Pacut (fall)	For the Faculty of Mathematics and Information Science
Computer Networks	CN	2 - 1 -	J.Sobczyk (spring/fall)	For the Faculty of Mathematics and Information Science
Information Technology Basics	ITB	1 - - -	A.Krzemienowski (fall)	For the Faculty of Architecture
Image and Speech Recognition	ISR	2 1 1 -	W.Kasprzak (fall)	For the Faculty of Mathematics and Information Science
Electrical Engineering and Electronics	EE	1 - 1 -	J.Gustowski (spring)	For the Faculty of Chemistry

Course Title	Course code	Hours per week	Lecturer	Notes
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
Advanced Control Techniques	ZTS	2 - 2 -	P.Tatjewski (spring)	For the Faculty of Mechatronics

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 30-09-2021.

Principal investigator from WUT: Tomasz Winiarski.

Investigators from WUT: Tomasz Winiarski, Wojciech Dudek, Dawid Serebyński, Maciej Stefańczyk, Maciej Węgierek, Maciej Bogusz, Jerzy Kołakowski (IRE), Cezary Zieliński, Wojciech Szynkiewicz, Włodzimierz Kasprzak, Vitomir Djaja-Joško (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] NCN Grant OPUS 9 no: UMO-2015/17/B/ST6/01885 **Energy-aware computer system for HPC computing**

Granting period: 18.02.2016–17.02.2019

Principial investigators: Ewa Niewiadomska-Szynkiewicz, Michał Karpowicz, Michał Marks

The project aim is to provide theoretical and engineering results that will support the ICT community with design patterns of energy-aware resource and job management systems capable of introducing guarantees for power consumption and application performance in data centers. Contributions in the area of energy-efficient computing will also support growth of the market of environment-friendly cloud services. The expected results may improve competitiveness of Polish ICT solutions as well as the involvement in the mainstream EU Exascale computing project. The project addresses the problem at the nexus of computer science, stochastic optimal control, control engineering, and communication, proving its interdisciplinarity. The obtained results will be validated numerically (AMPL, Matlab) and experimentally [H2]. Selected algorithms will be implemented (C/C++) and published as an open source software modules of the Linux kernel and SLURM cluster management system. The results of theoretical studies will be published in high impact journals and conference proceedings. Dissemination of the project outcomes will include presentations and exhibitions. Moreover, the results of research will be utilized in habilitation dissertations of the project contractors.

[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 automatically generated 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**

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] Rector's Grant No. 504440300031: **Components development for research and didactic variable locomotion mode robots**

Granting period: 29-05-2019 31-12-2019.

Principal investigator: Tomasz Winiarski. Investigators: Maciej Bogusz, Jakub Ciemięga, Wojciech Dudek, Kamil Foryszewski, Daniel Giełdowski, Piotr Kostrzeński, Adam Kowalewski, Piotr Matysiak, Adam Nowakowski, Maciej Radzimirski, Michał Romanowski, Michał Salej, Dawid Seredyński, Michał Stolarz, Klaudia Stpiczyńska, Maciej Węgierek.

Aim of the project: The main goal of the project is to develop a research -didactic platform, as a continuation of Students Interest Club "Bionik" work from the former years.

Expected results: The expected result of the work will be the creation of a research-didactic setup consisting of a group of mobile robots „MiniRyś”, a board and a global location system. Part of the work has already begun, as part of previous Rector's Grant (2016 and 2018).

The goals to be performed under the current Grant are:

- Verification of the „MiniRyś” mobile robot in the fourth version.
- Construction of the group of "MiniRyś" robots in the fourth version.

Keywords: mobile robot, microcontroller, ROS

[PR9] Dean's Grant No. 504/04334/1031: **Automatic code generation of a robot controller collecting table-tennis balls based on a formal specification expressed by means of a hierarchical Petri net**

Granting period: 08-07-2019 31-12-2019.

Principal investigator: Maksym Figat.

Aim of the project: The main scientific goal of this project is to develop a tool enabling specification of the robotic system and then based on it generation of robot driver code.

Expected results: As a result of the research, the following achievements are expected:

- developing a tool to specify robotic systems and automatic code generation for ROS,
- writing an article for a highly-rated robotic magazine,
- preparation of the experiment required in the doctoral dissertation.

Keywords: Robotic system specification methodology, Robotic system design methodology, Communication model, Hierarchical Petri Net, ROS, RSHPN Tool

[PR10] Dean's Grant No. 504/04331/1031: **Modeling post-mortem changes in the iris Granting period: 08-07-2019 31-12-2019**

Principal investigator: Mateusz Trokielewicz, Investigator: Piotr Maciejewicz.

Aim of the project: With increasing interest in employing iris biometrics as a forensic tool for identification by investigation authorities, there is a need for a thorough examination and understanding of post-mortem decomposition processes that take place within the human eyeball, especially the iris. This can prove useful for fast and accurate matching of ante-mortem with post-mortem data acquired at crime scenes or mass casualties, as well as for ensuring correct dispatching of bodies from the incident scene to a mortuary or funeral homes. Following these needs of forensic community, this work offers an analysis of the coarse effects of eyeball decay done from a perspective of automatic iris recognition point of view.

Expected results: Determining the dynamics of post-mortem changes in the eyes, the impact they may inflict on automatic iris recognition methodologies, as well as coming up with a set of guidelines and good practices for forensic experts dealing with post-mortem iris recognition, for instance as a part of criminal proceedings. This work analyzes post-mortem iris images acquired for a subject with a very long post-mortem observation time horizon (34 days), in both visible light as well as in near-infrared light (860 nm), as the latter wavelength is used in commercial iris recognition systems. Conclusions and suggestions are provided that may aid forensic examiners in successfully utilizing iris patterns in post-mortem identification of deceased subjects. Initial guidelines regarding the imaging process, types of illumination, resolution are also given, together with expectations with respect to the iris features decomposition rates. A preparation and submission of a paper manuscript for the International Journal of Legal Medicine..

Keywords: iris recognition, biometrics, post-mortem

[PR11] Dean's Grant No. 504/04332/1031: **Implementation of fast Nonlinear Model Predictive Control Algorithms for embedded systems**

Granting period: 08-07-2019 31-12-2019 Principal investigator: Patryk Chaber

Aim of the project: The aim of proposed research is to design fast algorithms of nonlinear model predictive control for embedded systems. Description of the work

carried out: The work carried out include research of capabilities and efficiency of utilisation of Laguerre functions to simplify control task both with the help of automatic differentiation and neural networks to approximate derivatives. Research was performed both in simulated environment (MATLAB), and using embedded systems (STM32 microcontrollers), which allowed to determine their efficiency and scope of usability. Research experiments based on microcontrollers allowed to determine practicality of considered algorithms and mechanisms, in particular their ability to respect time and memory constraints and their robustness in terms of measurement noise filtration/rejection.

Expected results: Performed research allowed to determine directions of further works which will allow to achieve best results in terms of shortening calculation time of nonlinear model predictive controllers. Conclusion of this research were presented e.g. in a paper, submitted for a Polish Control Conference PCC'2020, with a title of „Fast Nonlinear Model Predictive Control Algorithm with Neural Approximation for Embedded Systems: Preliminary Results” (with a prof. Maciej Ławryńczuk as a co-author). This work will be further expanded, specifically an ability to utilize automatic differentiation to determine training data for neural network, in aim to approximate the matrix of derivatives of MPC-NPLT-NA.

Keywords: Laguerre functions, automatic differentiation, model predictive control, embedded systems

[PR12] Dean's Grant No. 504/04333/1031: **Innovative inspection system for pressure leaks based on a dedicated vision system and proprietary ultrasonic sensor using FFT**

Granting period: 08-07-2019 31-12-2019 Investigators: Andrzej Wojtulewicz

Aim of the project: Leak testing is very widely used in many industries. Industrial plants in the fuel and chemical industry are subject to special consideration, where the tightness of the installation is primarily concerned with safety and in the second place financial savings. The main focus is on controlling critical points of the installation such as welded joints, valves, flanges, fittings and other components vulnerable to easy damage. Ultrasonic measurement has a number of advantages over traditional methods of searching for leaks. Among other things, the directionality of the measurement should be emphasized, thanks to which, together with the industrial robot, the leakage location can be precisely determined. The second important advantage is the lack of invasiveness at the place of measurement with an ultrasonic sensor – the measurements do not have to interfere with the continuous operation of the device. The third important advantage of the measurement is its speed – the answer is almost immediate. In addition, in areas hazardous to human life, the system will be able to perform its functions without any problems. The development of an ultrasonic sensor with an algorithm for frequency analysis of the measuring signal will allow precise determination of the level of leakage and its location in space. The vision system will perform a dual task. First, it will determine the precise location of the test site. This will be the basis for further measurement using an ultrasonic sensor. The second task of the vision system is to detect the "bubble" effect occurring in the place of gas leakage – previously the place will be sprayed with a suitable preparation.

Expected results: The result of the work will be the implementation of a prototype of an innovative system for inspecting pressure leaks. The obtained results will be the basis for preparing publications for the conference and for writing the preliminary version of the article for the higher-rated magazine.

Keywords: ultrasound, pressure installations, leakage, industrial robot, vision system, ultrasonic sensor, FFT, uC, PLC

[PR13] Statutory Grant: **Development of methodology of control, decision support and production management.**

Granting period: 27.08.2018–30.09.2019

Principal investigators: Ewa Niewiadomska-Szynkiewicz, Andrzej Pacut, Włodzimierz Ogryczak, Krzysztof Sacha, Maciej Ławryńczuk, Eugeniusz Toczyłowski, Cezary Zieliński, Włodzimierz Kasprzak.

[PR14] 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 services.**

Principal investigator: Andrzej Zalewski.

[PR15] 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 opinions on the information systems and services.

Principal investigator: Andrzej Zalewski.

[PR16] **Research agreement No. 501210102042 with PayEye Sp.z o.o.**

Granting period: 14.08.2019 – 25.11.2019. Principal investigator from WUT: Andrzej Pacut

[PR17] 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 Ph.D. Degrees

Advisor: **A. Pacut and A. Czajka**

Mateusz Trokielewicz

Iris Recognition Methods Resistant to Biological Changes in the Eye

Thesis defended on July 18, 2019, with honors

Advisor: **K. Sacha and W. Ogryczak**

Szymon Kijas

Decyzje architektoniczne w ewolucji systemów o architekturze usługowej

Thesis defended on September 10, 2019

5.2 M.Sc. Degrees

Advisor: **Piotr Bilski**

K. Kasprzyk

System wspomagający pracowników logistycznych z wykorzystaniem heurystycznych metod optymalizacji oraz geolokalizacji

Degree awarded in April 2019

Advisor: **Krzysztof Cabaj (II)**

P. Żórawski

Metody grupowania i klasyfikacji próbek złośliwego oprogramowania na podstawie ich aktywności sieciowej

Degree awarded in March 2019

Advisor: **Paweł Domański**

M. Jarzemski

Modelowanie agentowe ruchu samochodowego i pojawiania się korków

Degree awarded in October 2019

F. Russek

Wpływ czasu obliczeń na jakość regulacji dyskretnej

Degree awarded in October 2019

Advisor: **Janusz Granat**

D. Bocheński (OKNO)

Wykorzystanie algorytmów big data w analizie danych liczników energii elektrycznej

Degree awarded in April 2019 (with honors)

M. Chołodziński

Big data i uczenie maszynowe w czasie rzeczywistym w zastosowaniach przemysłowych (Industry 4.0)

Degree awarded in April 2019

K. Zieliński

Budowa systemu rekomendacji z wykorzystaniem uczenia maszynowego i grafowych baz danych

Degree awarded in October 2019

T. Korzeniowski

Wykorzystanie modelu przetwarzania systemu STORM do wykrywania anomalii

Degree awarded in October 2019

Advisor: **Jerzy Gustowski**

W. Gerstenstein

Przenoszenie obiektów przez manipulator z wykorzystaniem zewnętrznego systemu wizyjnego

Degree awarded in October 2019

Advisor: **Artur Janicki (TK)**

A. Zygałło

System automatycznego generowania korpusów mowy

Degree awarded in March 2019 (with honors)

Advisor: **Stanisław Jankowski (ISE)**

A. Gołębiowski (OKNO)

Maszyna RecurrentGOFR do ekstrapolacji nieliniowych równań różniczkowych

Degree awarded in October 2019

Advisor: **Mariusz Kaleta**

M. Rek

Rozproszony handel energią z wykorzystaniem blockchain

Degree awarded in June 2019

B. Wróblewski (OKNO)

Bilansowanie rynku energii elektrycznej z wykorzystaniem technologii off-chain

Degree awarded in October 2019

Advisor: **Mariusz Kamola**

B. Laskowska

Grupowanie utworów muzycznych

Degree awarded in April 2019 (with honors)

Ł. Fijas

Modelowanie ruchu drogowego na podstawie danych rzeczywistych

Degree awarded in June 2019

P. Poniedziałek

Analiza wydziwisku zdania na podstawie drzewa rozbioru

Degree awarded in October 2019

Advisor: **Włodzimierz Kasprzak**

K. Dreliszak

Identyfikacja użytkownika w sygnale audio

Degree awarded in October 2019

Advisor: **Henryk Kowalski (II)**

M. Dzięciołowski

Bezprzewodowe sieci czujników z transmisją dwupasmową

Degree awarded in October 2019

Advisor: **Adam Krzemienowski**

D. Rogowski

System wieloagentowy do symulacji gospodarki oraz wpływu waluty lokalnej na cykle koniunkturalne

Degree awarded in April 2019 (with honors)

M. Wachowicz

Zastosowanie systemu wieloagentowego do badania wpływu procesu kreacji pieniądza na cykle koniunkturalne

Degree awarded in April 2019 (with honors)

Advisor: **Tomasz Kruk**

K. Stałęga

Praktyczne metody wykrywania podatności w kodzie źródłowym

Degree awarded in October 2019

Advisor: **Maciej Ławryńczuk**

S. Taras

Krytyczne porównanie struktur Hammersteina i Wienera w zagadnieniach modelowania procesów dynamicznych i regulacji predykcyjnej

Degree awarded in October 2019

K. Staszkievicz

Rekurencyjne modele neuronowe z radialnymi funkcjami bazowymi

Degree awarded in October 2019 (with honors)

Advisor: **Piotr Marusak**

A. Piórkowski

Zastosowanie modeli hiperbolicznych w regulacji predykcyjnej

Degree awarded in March 2019 (with honors)

R. Nebeluk

Układy regulacji predykcyjnej z trajektorią referencyjną oraz trajektorią współczynników wagowych przewidywanych uchybów regulacji zmiennymi na horyzoncie predykcji

Degree awarded in March 2019

A. Czopor

Zastosowanie metod optymalizacji do strojenia algorytmów regulacji predykcyjnej nieliniowych obiektów

Degree awarded in October 2019

Advisor: **Grzegorz Mazur (II)**

K. Hamera (OKNO)

Urządzenie do badania źródeł stałoprądowych z dynamicznym, aktywnym obciążeniem z interfejsem www

Degree awarded in April 2019

Advisor: **Robert Nowak (II)**

R. Kluz

Przewidywanie decyzji uczestnika zdarzenia drogowego wykorzystując rozszerzanie zbioru danych i uczenie maszynowe

Degree awarded in April 2019

Advisor: **Ewa Niewiadomska- Szyrkiewicz**

M. Lew

Symulator bezprzewodowej sieci Bluetooth Mesh

Degree awarded in April 2019

J. Meller

Równoległy hierarchiczny algorytm genetyczny w technologii CUDA

Degree awarded in April 2019

J. Wetesko

Wykrywanie złośliwych aplikacji na platformie Android za pomocą metod uczenia maszynowego

Degree awarded in June 2019

Advisor: **Włodzimierz Ogryczak**

P. Pankiewicz

Wspomaganie sprawiedliwego rozdziału zadań na przykładzie złożonego systemu transportowego

Degree awarded in October 2019

Advisor: **Andrzej Pacut**

P. Kaźmierczyk

Wykorzystanie sieci neuronowych przy rozwiązywaniu problemu przemysłowego

Degree awarded in October 2019

Advisor: **Piotr Pałka**

M. Borkowski

Wykorzystywanie systemów wieloagentowych w modelowaniu ewolucji społecznej Smart City

Degree awarded in March 2019

O. Kowalski

Wykorzystanie urządzeń internetu rzeczy w pomocy niepełnosprawnym

Degree awarded in October 2019

Ł. Jakubczak

Technologia Blockchain w archiwizacji zasobów cyfrowych

Degree awarded in October 2019

Advisor: **Sebastian Plamowski**

K. Kuryluk

System do monitorowania składu hałdy węgla z wykorzystaniem zdjęć 3D z dronów

Degree awarded in March 2019

M. Mariański

System informatyczny wspomagający pracę instalacji nawęglania bloku energetycznego

Degree awarded in March 2019

M. Skryśkiewicz

Utworzenie i analiza systemu wspomagania decyzji oddziału firmy zajmującej się licencjonowaniem oprogramowania CAD

Degree awarded in June 2019

P. Kaczmarczyk

Metody eksploracji danych w diagnostyce procesów przemysłowych

Degree awarded in June 2019

Advisor: **Andrzej Ratkowski**

A. Olborski

Współpraca różnych środowisk dostawców przetwarzania obliczeń chmurowych

Degree awarded in March 2019

J. Skrętowski

Metodyka porównawcza platform chmurowych

Degree awarded in March 2019

Advisor: **Przemysław Rokita (II)**

P. Grzegorski

Efektywne wyszukiwanie obrazów na podstawie zawartości

Degree awarded in March 2019

Advisor: **Andrzej Stachurski**

J. Woś

Tworzenie harmonogramu konferencji naukowych przy niekompletnych danych

Degree awarded in June 2019

C. Dubiel

Techniki optymalizacji dyskretnej w eksploracji danych

Degree awarded in October 2019

Advisor: **Wojciech Szynkiewicz**

Ł. Meyer

Sterowanie predykcyjne z wykorzystaniem wizji w zadaniu śledzenia ścieżki przez robota mobilnego

Degree awarded in March 2019

Ł. Korpala

Środowisko symulacyjne do badania manipulacji dwuręcznej robota

Degree awarded in March 2019

M. Barciński

Wielomodalne sterowanie systemem okienkowym

Degree awarded in June 2019

Advisor: **Piotr Tatjewski**

R. Goluch

Realizacja regulatorów predykcyjnych z wykorzystaniem mikrokontrolera Cortex-M7. Ocena wpływu szumu kwantyzacji i szumu pomiarowego na jakość regulacji

Degree awarded in March 2019

Advisor: **Tomasz Traczyk**

P. Dąbrowski

Rozbudowa systemu EqDb oraz jego integracja z systemem R&MInteliphy

Degree awarded in October 2019

Advisor: **Tomasz Trzeciński**

A. Kozak

Piwa według sprzedawców i konsumentów – eksploracja danych tekstowych i zadanie automatycznej generacji tekstu w oparciu o głębokie sieci neuronowe

Degree awarded in March 2019

Advisor: **Tomasz Winiarski**

J. Postępski

Kompensacja siły grawitacji związanej z chwytanym przedmiotem za pomocą regulatorów PID

Degree awarded in October 2019

Advisor: **Andrzej Zalewski**

K. Borowa

Błędy poznawcze a inżynieria oprogramowania

Degree awarded in January 2019

J. Baranowski

Porównanie systemów czasu rzeczywistego w lotniczych systemach o zaostrzonych kryteriach bezpieczeństwa

Degree awarded in April 2019

K. Lisocki

Wielowymiarowe decyzje architektoniczne i ich wspomaganie

Degree awarded in October 2019

Y. Paseka

Analiza i ocena architektur korporacyjnych opisanych językiem ArchiMate

Degree awarded in October 2019

Advisor: **Cezary Zieliński**

Suman Ghosh (EMARO, Faculty of Power and Aeronautical Engineering)

Event-driven, Bio-inspired Online Depth Estimation for Scene Exploration on the iCub

Degree awarded in 2019

Advisor: **Izabela Żółtowska**

M. Zięba (OKNO)

Wspomaganie planowania zakupu energii elektrycznej przy zmiennych cenach przez odbiorcę z magazynem

Degree awarded in June 2019

A. Cieślak (OKNO)

System wspomagania doboru taryf i zamówień mocy dla obiektów handlowych i przemysłowych

Degree awarded in June 2019

K. Drabarz

Projekt i analiza platformy wspomagającej weryfikację pracy studentów nad zespołowym projektem informatycznym

Degree awarded in October 2019

5.3 B.Sc. Degrees

Advisor: **Piotr Arabas**

A. Piotrowski

Wyszukiwarka tras turystycznych

Degree awarded in September 2019

Advisor: **Patryk Chaber**

J. Wieczorek

Projekt systemu dynamicznego pozycjonowania i systemu referencyjnego do regulacji pozycji modelu pływającej platformy wiertniczej

Degree awarded in February 2019

Advisor: **Paweł Domański**

M. Biernat

Porównanie poboru mocy paneli słonecznych względem ich orientacji

Degree awarded in January 2019

R. Koguciuk

Optymalizacja produkcji energii elektrycznej przez farmę wiatrową poprzez przekierowanie cienia aerodynamicznego

Degree awarded in January 2019

K. Bogusz

Nowoczesna architektura regulatora PID a regulacja predykcyjna – rachunek zysków i strat

Degree awarded in January 2019

B. Rajkowski

Metody strojenia regulatorów PID dla różnych wskaźników jakości

Degree awarded in February 2019

P. Czajkowski

Zastosowanie entropii w ocenie jakości regulacji

Degree awarded in September 2019

Advisor: **Janusz Granat**

T. Zieliński

Modułowe środowisko do budowy symulatorów rynku

Degree awarded in February 2019

Advisor: **Mariusz Kaleta**

P. Dąbrowski

Aplikacja webowa do rozwiązywania problemu przydziału zasobów

Degree awarded in February 2019

M. Krysa

Projekt i implementacja systemu realizującego zdecentralizowany handel energią elektryczną w oparciu o Blockchain

Degree awarded in February 2019

P. Zych

Aplikacja internetowa wspomagająca zarządzanie ryzykiem na Towarowej Giełdzie Energii

Degree awarded in June 2019

P. Goczyński

Rozbudowa kompilatora języka DOML o obsługę solvera IPOPT

Degree awarded in September 2019

M. Suchocki

Aplikacja wspierająca planowanie zadań pracownikowi organizacji zwinnej

Degree awarded in September 2019

Advisor: **Mariusz Kamola**

D. Trusiński

Aplikacja webowa do wynajmu obiektów sportowych

Degree awarded in February 2019

J. Kochanowski

Zestaw modułów analitycznych do środowiska Fiware

Degree awarded in February 2019

Advisor: **Andrzej Karbowski**

K. Wyskiel

Badania porównawcze możliwości języków modelowania optymalizacyjnego: Pyomo, JuMP oraz AMPL

Degree awarded in February 2019

K. Orłowski

Comparative research on the possibilities of the Chapel language and OpenMP threads in relation to the implementation of parallel optimization calculations in a multi-core environment

Degree awarded in June 2019

Advisor: **Michał Karpowicz**

J. Lipiński

Indentyfikacja modelu serwera aplikacji w środowisku jądra system Linux

Degree awarded in February 2019

Advisor: **Włodzimierz Kasprzak**

M. Khombak

Rozpoznawanie komend głosowych zależne od mówcy

Degree awarded in February 2019

K. Dziurlikowski

Aplikacja do weryfikacji mówcy za pomocą modelu GMM/UBM

Degree awarded in September 2019

Advisor: **Piotr Marusak**

A. Świerczek

Aplikacja wspomagająca dobór kształtu funkcji przynależności regulatorów rozmytych z uwzględnieniem ich wpływu na jakość regulacji

Degree awarded in February 2019

P. Wilczyński

Wpływ kształtu funkcji przynależności na proces projektowania regulatora rozmytego i jakość regulacji

Degree awarded in February 2019 (with honors)

Advisor: **Ewa Niewiadomska – Szyrkiewicz**

P. Kowalczyk

System zdalnego sterowania ogrzewaniem jako element inteligentnego domu

Degree awarded in February 2019

Advisor: **Włodzimierz Ogryczak**

M. Kasprzyk

Optymalizacja portfela inwestycyjnego współczynnikiem Omega

Degree awarded in February 2019

Advisor: **Andrzej Pacut**

B. Boczek

Rozpoznawanie mówcy z wykorzystaniem głębokich sieci neuronowych

Degree awarded in February 2019

Advisor: **Piotr Pałka**

M. Dziejic

Implementacja mobilnej aplikacji do wyboru parkingu w Smart City przy użyciu systemu wieloagentowego

Degree awarded in February 2019

A. Kwiatkowski

Implementacja systemu do nauki liter wykorzystującego elementy rzeczywistości rozszerzonej

Degree awarded in February 2019

A. Zabłocki

Proceduralne generowanie muzyki na podstawie dynamicznie zmieniających się parametrów

Degree awarded in March 2019

P. Miszczyk

Zastosowanie systemów wieloagentowych w elementach Internetu rzeczy

Degree awarded in September 2019

Advisor: **Sebastian Plamowski**

S. Juszczyński

Projekt system sterowania PLC oraz wizualizacji SCADA dla modelu procesu produkcyjnego

Degree awarded in February 2019

M. Pawliński

Wpływ wskaźników jakości na parametry generowanego sygnału sterowania przy doborze nastaw regulatorów PID

Degree awarded in January 2019

M. Pisarczyk

Optymalizacja punktu pracy obiektu sterowania na przykładzie stanowiska grzejno-chłodzącego

Degree awarded in February 2019

M. Kłos

Opracowanie i implementacja modelu stanowiska systemu wentylacji

Degree awarded in January 2019

T. Ziernicki

Porównanie wybranych metod autostrojzenia regulatora PID

Degree awarded in January 2019

Advisor: **Dariusz Radomski (IRE)**

I. Dusza

Sterowanie dawkowaniem insuliny u pacjentów z cukrzycą typu I na modelu symulującym dynamikę glukozowo-insulinową w organizmie

Degree awarded in January 2019

Advisor: **Andrzej Ratkowski**

P. Więckowski

System do zarządzania rekrutacją kandydatów na stanowiska z wykorzystaniem asynchronicznych mikroserwisów oraz aplikacją kliencką

Degree awarded in January 2019

Advisor: **Przemysław Rokita (II)**

M. Weigle

Wykorzystanie robotów konwersacyjnych na potrzeby systemu pytanie-odpowiedź w interfejsie graficznym

Degree awarded in January 2019

Advisor: **Ryszard Romaniuk (ISE)**

K. Wąsik

Platforma do badania algorytmów lokalizacji źródła sygnału radiowego

Degree awarded in April 2019

Advisor: **Andrzej Stachurski**

P. Grabarski

Interaktywna mapa kawiarenek i klubów w Warszawie na urządzenia mobilne

Degree awarded in February 2019

Advisor: **Maciej Stefańczyk**

T. Bocheński

Rozpoznawanie zadanych obiektów w obrazach i sekwencjach wideo RGB i 3D

Degree awarded in September 2019

Advisor: **Marcin Szlenk**

M. Jezierski

Zestaw generycznych narzędzi programistycznych do budowania wirtualnych wersji gier karcianych

Degree awarded in February 2019

Advisor: **Wojciech Szynkiewicz**

M. Macutkiewicz

Autonomiczna nawigacja pojazdu kołowego

Degree awarded in September 2019

Advisor: **Tomasz Śliwiński**

M. Prystupiuk

Wspomaganie projektowania map do gier strategicznych

Degree awarded in September 2019

Advisor: **Tomasz Traczyk**

E. Kowalska (Institute of Computer Science)

Opracowanie i implementacja metody importu danych ze źródeł semistrukturalnych do bazy danych o strukturze generycznej,

Degree awarded in September 2019

Advisor: **Tomasz Winiarski**

K. Foryszewski

Robot mobilny MiniRys

Degree awarded in June 2019

M. Romanowski

Sterowanie prototypowym robotem manipulacyjnym Bombel

Degree awarded in June 2019

Advisor: **Andrzej Wojtulewicz**

P. Barański

Implementacja algorytmu regulacji predykcyjnej DMC w sterowniku przemysłowym PLC z wizualizacją w systemie SCADA. Opracowanie uniwersalnej biblioteki dla sterownika PLC, przygotowanie warstwy prototypowania w środowisku MATLAB

Degree awarded in February 2019

P. Puton

Opracowanie systemu cyfrowego realizującego sterownik PLC w oparciu o układy FPGA. Implementacja oprogramowania narzędziowego do realizacji programów wykonawczych

Degree awarded in February 2019 (with honors)

M. Janeczko

Opracowanie kompleksowego systemu sterowania zaawansowanymi liniami technologicznymi z użyciem sterowników PLC oraz systemu SCADA

Degree awarded in February 2019

Advisor: **Tomasz Trzcíński (II)**

P. Lis

Time series prediction engine forecasting Veturilo stations' bicycle congestions

Degree awarded in February 2019

Advisor: **Andrzej Zalewski**

M. Derdak

Internetowy, modułowy system wspierający zarządzanie projektami zgodnie z metodyką Prince2

Degree awarded in February 2019

A. Rybak

System wspomagający podejmowanie decyzji architektonicznych przy użyciu notacji MAD 2.0

Degree awarded in February 2019

Advisor: **Izabela Żółtowska**

B. Grudniewski

Projekt i implementacja aplikacji wspomagającej harmonogramowanie pracy zmianowej

Degree awarded in February 2019

B. Mielczarek

Wybrane modele i metody planowania ładowania pojazdów elektrycznych z uwzględnieniem zapotrzebowania na energię zlokalizowaną

Degree awarded in February 2019

K. Biduś

Równoważenie rozmieszczenia rowerów na stacjach Veturilo

Degree awarded in February 2019

M. Mokrogulski

Zarządzanie ładowaniem pojazdów elektrycznych z wykorzystaniem aukcji uwzględniającej mobilność

Degree awarded in June 2019

K. Jaszczuk

Projekt i implementacja narzędzia do estymacji kosztów overbookingu

Degree awarded in September 2019

K. Pelc

Projekt i implementacja generatora danych dla jednopoziomowego modelu zarządzania łańcuchami dostaw

Degree awarded in September 2019

K. Kaczmarek

System wspomagający wyznaczanie trasy łącznej dla Veturilo i ZTM w Warszawie

Degree awarded in September 2019

K. Drabarz

Projekt i implementacja algorytmów agregacji i dezagregacji ofert pojazdów elektrycznych

Degree awarded in December 2019

6 Publications

6.1 Scientific or Technical Books

[B1] P. Pałka, *Wieloagentowe systemy decyzyjne*, Warszawa, 2019.

6.2 Scientific and Technical Papers in Books and Conference Proceedings

- [P1] P. P. Arabas and E. Niewiadomska-Szynekiewicz, “Energy-efficient workload allocation in distributed HPC system”, in *The 2019 International Conference on High Performance Computing & Simulation HPCS 2019*, 2019, pp. 470–477.
- [P2] M. Azimi, S. A. Rasoulinejad, and A. Pacut, “The effects of gender factor and diabetes mellitus on the iris recognition system’s accuracy and reliability”, in *2019 Signal Processing: Algorithms, Architectures, Arrangements, and Applications (SPA)*. IEEE, 2019, pp. 273–278.
- [P3] P. Domański, M. Ławryńczuk, S. Golonka, B. Moszowski, and P. Matyja, “Multi-criteria loop quality assessment: A large-scale industrial case study”, in *The 24th International Conference on Methods and Models in Automation and Robotics*, 2019, pp. 99–104.
- [P4] W. Dudek, M. Węgierek, J. Karwowski, W. Szynekiewicz, and T. Winiarski, “Task harmonisation for a single-task robot controller”, in *12th International Workshop on Robot Motion and Control*, 2019, pp. 86–91.
- [P5] M. Falkowski and P. Domański, “Residual analysis of nested narima models of the atmospheric distillation column”, in *2019 18th European Control Conference IEEE (ECC)*, 2019, pp. 369–374.
- [P6] M. Figat and C. Zieliński, “Methodology of designing multi-agent robot control systems utilising hierarchical petri nets”, in *IEEE International Conference on Robotics and Automation ICRA 2019*, 2019, pp. 3363–3369.
- [P7] M. Getka and M. Karpowicz, “Fixed-point self-tuning CPU performance controller for linux kernel”, in *The 2019 International Conference on High Performance Computing & Simulation HPCS 2019*, 2019, pp. 470–477.
- [P8] C. Grelck, E. Niewiadomska-Szynekiewicz, M. Aldinucci, A. Bracciali, and E. Larsson, “Why high-performance modelling and simulation for big data applications matters”, in *High-Performance Modelling and Simulation for Big Data Applications*, ser. Lecture Notes In Computer Science, J. Kołodziej and H. Gonzalez-Velez, Eds. Springer International Publishing, 2019, vol. 11400, pp. 1–35.
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