

# **Institute of Control and Computation Engineering**

## **2018 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 Universität Magdeburg (Germany) and WUT (Poland). The project focuses on addressing a range of current issues facing biometric solutions on mobile devices. Furthermore, the Biometrics and Machine Learning Group with the Machine Perception Group was involved in the National Centre for Research and Development project Design and construction of a system for recognition of persons (offenders) based on face images captured on photograph or video material (BIOWIZ). The project was completed in September 2018. It was led by prof. Andrzej Pacut, the participating partners were: NASK-PIB, AGH University of Science and Technology and Polish Platform for Homeland Security. The biometric part of the system consisted of integrated modules, including face detection module, surveillance module, “biometric engines” for face and silhouette recognition and fusion module generating biometric profiles.

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.

The Robot Programming and Control Group in 2018 started a new National Centre for Research and Development project called INCARE – Integrated Solution for Innovative Elderly Care. It is an international project (the project leader is from Romania) in the framework of the AAL 2017 Call – AAL packages/Integrated solutions – Packages integrating different solutions based on ICT to support active, healthy and independent living of older adults. In the Institute of Control and Computation Engineering the project is led by Dr. Tomasz Winiarski.

MSc Maksym Figat (The Robot Programming and Control Group) and MSc Maciej Stefańczyk (The Machine Perception Group) are responsible for two National Science Centre PRELUDIUM research grants. The objective of the first project is to develop a methodology for designing robotic system controllers based on a formal specification, the second project is concerned with using depth data to correct perspective in RGB descriptors.

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. Krzysztof Malinowski who was given the Warsaw University of Technology Rector's Award for Lifetime Achievements. I also congratulate Dr. Tomasz Winiarski on being awarded with the Medal of the Commission of National Education.

*Włodzimierz Ogryczak*

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## 1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2018.

### 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**

<b>Division Head:</b>	Professor K. Malinowski
<b>Professors:</b>	W. Kasprzak, K. Malinowski, E. Niewiadomska-Szynkiewicz, A. Pacut, C. Zieliński
<b>Professors, retired:</b>	W. Findeisen, R. Ładziński, J. Szymanowski
<b>Assistant Professors:</b>	P. Arabas, M. Kamola, A. Karbowski, M. Karpowicz, T. Kornuta, A. Kozakiewicz, T.J. Kruk, W. Szynkiewicz, T. Winiarski, A. Wilkowski
<b>Software Engineers:</b>	M. Trokielewicz
<b>Assistant:</b>	D. Seredyński, M. Stefańczyk, M. Azimi, J. Nourmohammadi Khiarak, W. Dudek, M. Figat
<b>Ph.D. Students:</b>	W. Dudek, J. Figat, M. Figat, K. Gabor-Sitkowska, W. Gutfeter, M. Hałoń, J. Karwowski, M. Krzysztoń, P. Piwowski, D. Seredyński, M. Trokielewicz, 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, J. Figat, 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**

<b>Division Head:</b>	Professor P. Tatjewski
<b>Professors:</b>	M. Ławryńczuk, <span style="border: 1px solid black; padding: 0 2px;">K. Sacha</span> , P. Tatjewski
<b>Assistant Professors:</b>	P. Domański, P. Marusak, S. Plamowski, A. Zalewski
<b>Assistant:</b>	A. Wojtulewicz
<b>Senior Lecturers:</b>	J. Gustowski, A. Ratkowski, M. Szlenk
<b>Senior Engineer:</b>	W. Macewicz
<b>Ph.D. Students:</b>	P. Chaber, 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, 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, G. Mąkosa, W. Macewicz, K. Sacha, 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**

<b>Division Head:</b>	Professor E. Toczyłowski
<b>Professors:</b>	W. Ogryczak, E. Toczyłowski
<b>Professors, retired:</b>	W. Traczyk, A. P. Wierzbicki
<b>Readers:</b>	T. Traczyk
<b>Assistant Professors:</b>	J. Granat, B. Kozłowski, P. Pałka, K. Pieńkosz, A. Stachurski, T. Śliwiński, I. Żółtowska
<b>Assistant:</b>	A. Manujło
<b>Senior Lecturers:</b>	J. Sobczyk, M. Kaleta, A. Krzemienowski
<b>Ph.D. Students:</b>	A. Mościcka, G. Zalewski, M. Drabecki

Research of the division is conducted in 2 research groups:

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

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	2016 persons	2017 persons	2018 persons
<b>Academic Staff</b>	39(+3)	41(+2)	44(+2)
by titles/degrees			
Professors	9	9	8
D.Sc.-s	6	6	7
Ph.D.-s	18(+3)	17(+2)	19(+2)
M.Sc.-s	6	7	8
Others			2
by positions			
Professors	10	10	9
Readers	1	1	1
Assistant Professors	21(+3)	21(+2)	19(+2)
Senior Lecturers	3	3	6
Assistants	2	6	9
<b>Ph.D. Students</b>	19	19	28
<b>Technical Staff</b>	5	4	3
<b>Administrative Staff</b>	7	7	7

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

ACTIVITIES	2016	2017	2018
<b>Teaching activities</b>			
standard teaching potential, hours	9 187,80	9 494,20	9 785,01
# hours taught	14 107,40	14 962,00	14 097,90
<b>Degrees awarded</b>			
Professor	0	1	0
D.Sc	2	0	0
Ph.D.	0	1	1
M.Sc.	36	51	30
B.Sc.	49	37	69
<b>Research projects</b>			
granted by WUT	5	7	5
granted by State institutions	6	5	5
granted by international institutions	1	2	2
other	8	6	5
<b>Sci.-Tech. publications</b>			
monographs (authored or edited)	3	1	2
chapters in books and proceedings	60	29	26
papers in journals	32	30	22
<b>Reports, abstracts and other papers</b>	16	7	1
<b>Conferences</b>			
participation (# of conferences)	14	14	28
participation (# of part. from ICCE)	39	27	65

RESOURCES	2016	2017	2018
<b>Space (sq.m.)</b>			
laboratories	995	644	644
library + seminar room	74	182	182
faculty offices	724	821	821
<b>Computers</b>			
personal computers	185	172	221
<b>Library resources</b>			
books	3 154	3 154	3 176
booklets	2 809	2 959	2 959
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.

**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.

**Patryk Józef Chaber** Research Assistant Lecturer

**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**

w.a.dudek@elka.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 (since 2018)

**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**

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

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

*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.

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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

**Systems Control Division, Machine Perception Group**

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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.

**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.

**Adam Kozakiewicz** Assistant Professor (part time)

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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)

**Operations and Systems Research Division, Optimization and Decision Support Group**

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*M.Sc. 2004 from WUT.*

With WUT since 2010.

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

**Tomasz Jordan Kruk** Assistant Professor

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

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

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

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

**Operations and Systems Research Division, Optimization and Decision Support Group**

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*Ph.D. 2007 from WUT.*

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

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

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

**Control and Software Engineering Division, Control Engineering Group**

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

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

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

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

**Krzysztof Malinowski** Professor (Head of Division)

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*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–).

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

**Andrzej Manujło** Assistant (since Oct. 2018)

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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.

**Mohammadreza Azimi** Assistant**Systems Control Division, Biometrics and Machine Learning Group****room 560, tel. 22 234 7297**

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

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

**Jalil Khiarak Nourmohammadi** Assistant**Systems Control Division, Biometrics and Machine Learning Group****room 560, tel. 22 234 7297**Jalil.Nourmohammadi@elka.pw.edu.pl, <http://zbum.ia.pw.edu.pl/PL/node/102>**B.Sc. 2011, M.Sc. 2015**

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

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

**Ewa Niewiadomska-Szynkiewicz** Professor (Leader of the Group)**Systems Control Division, Complex Systems Group****room 572a, tel. 22 234 3650**E.Niewiadomska@ia.pw.edu.pl, [www.ia.pw.edu.pl/~ens](http://www.ia.pw.edu.pl/~ens)

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

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

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

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

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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)

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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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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–).

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

**Krzysztof Pieńkosz** Assistant Professor

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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

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

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

With WUT since 2009.

*Interests:* Software engineering, Service Oriented Architecture, performance engineering, IT architectures.

**Krzysztof Sacha** Professor

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*M.Sc. 1973, Ph.D. 1976, D.Sc. 1996 from WUT, the title of Professor of Technical Sciences awarded in 2011.*

With WUT since 1976, Full Professor since 2012. Designer in Minicomputer Research and Development Centre ERA (1973), Software Engineering Consultant for Industrial Automation Enterprise PNEFAL (1987–90), Visiting Researcher at the University of Groningen, The Netherlands (1991–1992), and Technical University of Denmark (1993), Senior Designer in Alerton Polska (1999–2002), Auditor evaluating software projects for public organizations and for the industry (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), Chairman of Strategic Research Programs Committee (2012–2014). Professor at Vistula University, Warsaw, Poland (2002–2015).

Member of the Supervisory Board of Atena Usługi Informatyczne i Finansowe S.A. (since 2015). Member of IEEE.

**Interests:** Software engineering, real-time systems, software architecture and architectural decisions, software quality, trust management.

**Dawid Seredyński** Assistant (since Oct. 2018)

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With WUT since 2012.

**Interests:** grasp planning, manipulation planning

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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.

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

**Maciej Stefańczyk** Assistant

**Systems Control Division, Machine Perception Group**

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*M.Sc. 2011*

With WUT since 2011

*Interests:* Computer vision, computer graphics.

**Marcin Szlenk** Assistant Professor (until Sept. 2018), Senior Lecturer (since Oct. 2018)

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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.

**Wojciech Szyrkiewicz** Assistant Professor

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

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

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

**Tomasz Śliwiński** Assistant Professor

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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–), Vice-chairman of the Scientific Council of Systems Research Institute of Polish Academy of Sciences (2011–). 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 (Head of Division)

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

With WUT since 1973. Head of Operations Research and Management Systems Division, Vice-Dean of the Faculty of Electronics at WUT (1990–1993), chairman of the Rector's Committee for University Computerization (1993–1999), Advisor to the Dean on Strategic Planning (1993–1996). Head of the Undergraduate Program in Information Systems for Decision Support (1992–2004). Member of the Section on Decision Support (since 1992) and the Section on Knowledge Engineering and Operations Research (2003–) of the Committee of Automation and Robotics of Polish Academy of Sciences, Member of the Scientific Council of the Systems Research Institute (IBS PAN) (since 2002), Member of Consulting Council EnergoProject S.A. (2003–2004), Member of Steering Committee of the Energy Market (2003–2004). Member of the Polish National Council for CO<sub>2</sub> 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.

**Artur Wilkowski** Assistant Professor (at ICCE since Oct. 2018)

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*M.Sc Eng 2004, Phd 2012 from WUT*

With WUT since 2006

**Interests:** Computer vision, Machine learning.

**Tomasz Winiarski** Assistant Professor

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

With WUT since 2004.

**Interests:** Robot control systems, artificial intelligence, mobile robots, impedance control, manipulator force control.

**Andrzej Marcin Wojtulewicz** Assistant

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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)

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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)

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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.*

With WUT since 2010.

**Dawid Seredyński** Software Engineer (part time), (Since Sept. 2018)

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## 2.4 Ph.D. Students

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**Kamil Czerwiński** Ph.D. Student

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**Jarosław Karwowski** Ph.D. Student (since Oct. 2018)

**Systems Control Division, Robot Programming Group**

*Supervisor:* Wojciech Szyrkiewicz

**Magdalena Konieczna-Wrzesień** Ph.D. Student (since Oct. 2018)

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*Supervisor:* Andrzej Zalewski

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### 3 Teaching Activities – Academic Year 2017/2018

#### 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
Optimization Algorithms and Methods	AMO	2 - - 2	A.Stachurski (fall)	
Anatomy of Robots	ANRO	1 - 2 -	T,Winiarski (spring)	
Systems Architecture and Integration	AIS	2 - 1 -	A.Ratkowski (spring/fall)	
Automation and Robotics Equipment	APA	2 - 1 -	T.Winiarski (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 (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)	
Networks Systems Control	SST	2 - - 1	K.Malinowski (spring)	
Object Programming	PROI	2 - 2 -	T.Śliwiński (fall)	
Operating System	EOPSY	2 1 1 -	T.Kruk (spring)	

Course Title	Course code	Hours per week	Lecturer	Notes
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 (spring/fall)	
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 -	K.Sacha (spring/fall)	
Robot Programming Methods	EPRM		C.Zieliński (spring)	
Signal Processing	ESPRO	2 1 - -	W.Kasprzak (fall)	
Software Engineering	IOP	2 - 1 -	K.Sacha (spring/fall)	
Software Specyfication and Design	SPOP	2 - 1 -	M.Szlenk (spring/fall)	
Soft Computing in Process Control	SZAU	2 - - 2	M.Ławryńczuk (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	AP	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
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

<b>Course Title</b>	<b>Course code</b>	<b>Hours per week</b>	<b>Lecturer</b>	<b>Notes</b>
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 Seredyński, Maciej Stefańczyk, Maciej Węgierek, Maciej Bogusz, Jerzy 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. DOB-BIO7/18/02/2015 **Design and construction of a system for recognition of persons (offenders) based on face images captured on photograph or video material.**

Granting period: 20.12.2015–20.09.2018.

Principal investigator: Andrzej Pacut.

Investigators from WUT: Włodzimierz Kasprzak, Władysław Skarbek.

The goal of this project is to build a system for biometric identification of perpetrators of offences or criminals based on photographs and/or video materials. The biometric part of the system will consist of integrated modules, including face detection module, surveillance module, “biometric engines” for face and silhouette recognition, and fusion module generating biometric profiles. Biometric modules will be integrated with a database, which will integrate the biometric data with the police records. The system is thought as an interactive tool and will be operating in various application scenarios, including face detection, isolation of video frames containing faces, surveillance in video materials and identification of persons marked on photo and video materials using the biometric profiles. Modular construction enables for easy supplementing the scenario list and actualization of biometric techniques. The system will be an indispensable tool for personal identification tasks.

Keywords: biometrics, identity identification, face detection, tracking, silhouette recognition.

[PR4] 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.

[PR5] 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

Principal 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.

[PR6] 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

[PR7] 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 Sereďyński, 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.

[PR8] Statutory Grant: **Development of methodology of control, decision support and production management.**

Granting period: 12.06.2017–31.10.2018 and 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.

[PR9] Rector's Grant No. 540020200082: **Development of research and didactic setups of mobile and manipulation robots**

Granting period: 29-05-2018 31-12-2018.

Principal investigator: Tomasz Winiarski.

Investigators: Maciej Bogusz, Wojciech Dudek, Kamil Foryszewski, Daniel Giełdowski, Piotr Matysiak, Michał Romanowski, Dawid Seredyński, Maciej Stefańczyk, Maciej Węgierek.

Aim of the project: It is planned to develop existing didactic platforms and to create their subsequent versions, as well as to prepare prototypes of subassemblies that may be integrated in future with research platforms. Expected results: The expected result of the work will be the creation of the third version of the "Bombel" manipulator, modification of mobile robots "MiniRyś", organization of individual training for members and candidates for members of the Students Interest Club Bionik, design and creation of a new board for mobile robots and creation of the first prototype of artificial skin'. The work carried out will extend the competences of the Club members with the ability to design and construct sensors of a new type. In addition, the development of existing platforms will help consolidate knowledge in a given field and conduct experiments aimed at testing new materials and sensors.

Keywords: Robotic manipulator, mobile robot with various modes of locomotion, tactile sensors.

[PR10] Dean's Grant No. 504/03067/1031: **Iris recognition using convolutional neural networks.**

Granting period: 17-05-2017 31-03-2018. Principal investigator: Mateusz Trokielewicz.

Aim of the project: The aim if this project is to evaluate a possibility of employing deep convolutional neural networks for the purpose of iris recognition after death, and also for liveness testing (presentation attack detection).

Expected results:

- exploring a possibility to build an iris image classifier based upon deep convolutional neural networks that would operate in an end-to-end manner, and/or a liveness detector that would decide whether a biometric sample is coming from a living organ

- delivering a unique database of iris images with corresponding masks denoting useful regions of an iris; the database would include “difficult” iris images, such as those coming from eyes of deceased subjects, or those with severe ocular disorders present; such a dataset can be then anonymized and shared with the scientific community
- preparing an article divulging the experiments and results and submitting it for an international conference or to a JCR journal
- sustaining the cooperation with the Department of Ophthalmology of the Medical University of Warsaw that enables us to proceed with many cutting-edge and highly novel studies regarding biological aspects of iris recognition.

Keywords: biometrics, iris recognition, neural networks, deep learning.

[PR11] Dean’s Grant No 504/03827/1031: **Methods for thermal hand images segmentation for heat distribution-based biometric recognition**

Granting period: 12-07-2018 31-12-2018.

Principal investigator: Mateusz Trokielewicz.

Investigator: Ewelina Bartuzi.

Aim of the project: The goal of the Project is to evaluate the use of convolutional neural networks for hand image segmentation in the thermal spectrum, as well as in visible light, and to assess the discriminatory capability of a biometric system employing such data. Expected results: A novel database comprising dense labels denoting useful palm regions, manually annotated for two different, publicly available databases of thermal and visible light hand images, which is unique and can be shared with other researchers. A deep learning-based method for segmenting difficult hand images, such as those collected in the thermal spectrum from subjects with palm regions (e.g., fingers) that are colder than the background. Evaluation of the proposed segmentation method within a complete biometric recognition system. Preparation of the manuscript intended for submission for one of the premier international biometrics-related conferences (such as ICB or BTAS).

Keywords: biometrics, hand recognition, thermal spectrum, semantic segmentation, deep learning.

[PR12] Dean’s Grant No. 504/03828/1031: **Using spherical cameras in service robotics**

Granting period: 12-07-2018 31-12-2018.

Principal investigator: Maciej Stefańczyk.

Aim of the project: The aim of the project is to test modern spherical cameras in service robotics tasks. In particular, four main topics are considered – motion detection, object tracking, human detection and surveillance.

Expected results: Testing different modern spherical cameras and checking their viability to use in robotics. Implementation of acquisition and image stitching methods for spherical data. Creation and adaptation of computer vision algorithms to work with spherical data.

Keywords: spherical cameras, computer vision, service robotics.

[PR13] Research agreement No. 1/PZ/06/2018 with SAMSUNG ELECTRONICS POLSKA Sp z o.o.: **Innovative ways of applying deep learning to the speaker recognition task**

Granting period: 17-09-2018 31-12-2018. Principal investigator: Andrzej Pacut.

Investigator: Bartłomiej Boczek.

The goal of this project was to examine capabilities of deep-learning based methods in text-independent speaker recognition systems. Solutions under consideration were based on deep convolutional neural networks of various types, including siamese networks. We applied neural networks in combination with various methods of transforming the speech signals to images, like spectrograms, cepstral features and wavelet transforms. Our experiments used Python programming language and Keras neural networks package. The speaker recognition results were compared with non-neural methodologies like i-vectors and probabilistic linear discriminant analysis (PLDA). System was tested on ICB2013 speaker recognition competition database.

- [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. 08626319/17817004-74 with Joint Institute for Nuclear Research, Dubna, Russia **Software for Equipment Database adaptation and putting into operation for NICA MPD.**

Granting period: 2017-07-11 2018-01-11. Principal investigator from WUT: Tomasz Traczyk.

Aim of the project: The objective of the work is to launch the EqDb software for NICA MPD experiment. The delivered version has been adapted for NICA MPD needs.

Equipment Database (EqDb) is a software tool supporting processes of construction, assembly, operation and maintenance of complex scientific equipment, particularly detectors in High Energy Physics experiments. EqDb is originally intended to be used for MPD (Multi-Purpose Detector) of NICA at JINR (Dubna, Russia). Thanks to EqDb generic, highly flexible data structure, the system can however be quite easily configured to support almost every type of complex scientific experiment. As EqDb can store information on all devices used in the experiment, it can become a backbone of the slow control system, and can also be used as a calibration database for the experiment.

- [PR16] Research agreement No. 1/PZ/04/2016 with Yield Planet SA: **Design of mathematical models (algorithms) and data analysis for forecasting and optimization of hotel room pricing.**

Granting period: 01-05-2016 30-04-2018. Principal investigator: Andrzej Pacut.

Investigators: Włodzimierz Ogryczak, Janusz Granat, Izabela Żółtowska, Piotr Arabas, Mariusz Kamola, Tomasz Śliwiński, Piotr Pałka, Jakub Szczepański.

Aim of the project: Design of database structures, mathematical models, algorithms, and programs for data analysis, forecast, price elasticity and optimization of hotel room pricing. Expected results: Mathematical models, algorithms and programs for data analysis, forecasting, price elasticity and hotel room price optimization, together with testing of the solutions, and data base structures design.

Keywords: big data analysis, forecasting, price elasticity, price policy, big data.

[PR17] 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 opinion on the information systems and services.

Principal investigator: Andrzej Zalewski.

[PR18] Research agreement No. 501210101730 with Zakłady Azotowe Kędzierzyn, Grupa Azoty S.A.: **Economic optimization template for ammonia synthesis plant.**

Granting period: 03-04-2018 3-12-2018.

Principal investigator from WUT: Paweł Domański.

The project "Economic optimization template for ammonia synthesis plant" consists of the conceptual and analytical work packages, which aim at the preparation of the plant for the introduction of the Advanced Process Control (APC) and economic optimization for the ammonia production installation in Grupa Azoty plant at Kędzierzyn-Koźle. The project focuses on the ammonia synthesis loop only. The following tasks are included in the project:

1. Preparation of the dynamical models in form of the step responses for process dynamic optimization and predictive control.
2. Identification of the process static models to be used by the supervisory optimization.
3. Preparation of the economic optimization template for the ammonia synthesis.
4. Estimation of the implementation benefits due to the APC and Process Optimization.

Keywords: ammonia synthesis, Advanced Process Control.

## 5 Degrees Awarded

### 5.1 Ph.D. Degrees

Advisor: **Prof. Maciej Ławryńczuk**

Patryk Chaber

*Automatyczna generacja kodu algorytmów regulacji predykcyjnej na mikrokontrolery*

Thesis defended on December 11, 2018

### 5.2 D.Sc. Degrees

Paweł Domański

Degree awarded on 27-03-2018

### 5.3 M.Sc. Degrees

Advisor: **Piotr Arabas**

W.Ślęczka

*Generowanie ruchu sieciowego o zadanej charakterystyce widmowej*

Degree awarded on April 2018

B.Lemiec

*Aplikacja wspierająca budowę i analizę grafu połączeń na podstawie danych z sond sieciowych*

Degree awarded on March 2018

Advisor: **Andrzej Ciemski (II)**

P.Kucharski

*System wspomaganie decyzji inwestycyjnych z wykorzystaniem hurtowni danych*

Degree awarded on June 2018 (with honors)

Advisor: **Paweł Domański**

A.Terwiński

*Regulacja obiektu przemysłowego wielowymiarowego z adaptacyjnym sygnałem wyprzedzającym*

Degree awarded on March 2018

T.Kowalski

*Zastosowanie regulacji adaptacyjnej MRAC do sterowania pieca łukowego*

Degree awarded on March 2018

Advisor: **Janusz Granat**

W.Klimczak

*Modelowanie i analiza wielokryterialna systemów wynagradzania pracowników*

Degree awarded on March 2018

M.Tkaczyk (OKNO)

*Wykorzystanie przetwarzania strumieniowego w zarządzaniu łańcuchem dostaw*

Degree awarded on June 2018

Advisor: **Jerzy Gustowski**

M.Olszewski

*Integracja stacji meteorologicznej z systemem inteligentnego domu*

Degree awarded on April 2018

P.Szyszka

*Badanie masy obiektu sprzężonej z silnikiem liniowym w środowisku BECKHOFF TwinCAT 3*

Degree awarded on April 2018

Advisor: **Mariusz Kaleta**

A.Nielipiński (OKNO)

*Projektowanie i wsparcie implementacji aplikacji opartych o architekturę mikroserwisów*

Degree awarded on October 2018 (with honors)

Advisor: **Andrzej Karbowski**

P. Łuc (OKNO)

*Możliwości ujednoczenia sposobu tworzenia aplikacji do SMART TV różnych producentów na przykładzie implementacji programu geolokalizacji*

Degree awarded on March 2018

Advisor: **Michał Karpowicz**

M.Getka

*Energooszczędny adaptacyjny system sterowania wydajnością procesora dla systemu Linux*

Degree awarded on March 2018

Advisor: **Adam Kozakiewicz**

A.Al-Batool

*Detecting botnet command and control servers through analysis of malware network traffic*

Degree awarded on March 2018

Advisor: **Tomasz Kruk**

R.Wądołowski

*Elektroniczna identyfikacja i usługi zaufania*

Degree awarded on October 2018

Advisor: **Maciej Ławryńczuk**

J.Sawulski

*Optymalizacja strategii użycia silnika pojazdu o minimalnym zużyciu paliwa*

Degree awarded on January 2018 (with honors)

P. Kallas

*Modelowanie i regulacja helikoptera laboratoryjnego*

Degree awarded on March 2018

Advisor: **Mateusz Malanowski (ISE)**

M.Konopko (OKNO)

*Analiza metod asocjacji pomiarów w systemach radiolokacji pasywnej PCL-PET*

Degree awarded on March 2018 (with honors)

Advisor: **Krzysztof Malinowski**

P.Drabiński

*Sterowanie popytem i magazynami energii w inteligentnym systemie energetycznym*

Degree awarded on March 2018

Advisor: **Piotr Marusak**

M.Wojtasiak

*Modele rozmyte Takagi-Sugeno z następnikami biliniowymi, zastosowanie w algorytmach regulacji*

Degree awarded on March 2018

Advisor: **Ewa Niewiadomska- Szynkiewicz**

A.Syroka

*Optymalizacja modelu danych bazy NoSQL na przykładzie Cassandra*

Degree awarded on March 2018 (with honors)

M.Poćwierz

*Warstwa kolekcji danych dla nowej wersji system Post Mortem działającego w Cern*

Degree awarded on June 2018

Advisor: **Andrzej Pacut**

R.Białoobrzęski

*Rozpoznawanie mówców na urządzeniach mobilnych*

Degree awarded on March 2018 (with honors)

Advisor: **Sebastian Plamowski**

B.Radzikowski

*Porównanie algorytmów regulacji na przykładzie helikoptera laboratoryjnego*

Degree awarded on March 2018 (with honors)

A.Krężel

*Model fizyczny budynku mieszkalnego – analiza porównawcza algorytmów regulacji temperatury*

Degree awarded on June 2018

Advisor: **Andrzej Ratkowski**

P.Stępień

*Aplikacja mobilna, bazująca na sygnale Wi-Fi, umożliwiająca lokalizowanie się wewnątrz budynku*

Degree awarded on March 2018

R.Okonski (OKNO)

*Rozproszony system monitorowania urządzeń mobilnych z wykorzystaniem architektury REST*

Degree awarded on June 2018

Advisor: **Przemysław Rokita (II)**

Ł.Kostyra

*Badanie technologii Asynchronous Compute z wykorzystaniem interfejsu Vulkan*

Degree awarded on March 2018

Advisor: **Marcin Szlenk**

Ł.Gajowy

*Tworzenie języków dziedzinowych w środowisku Meta Programming System*

Degree awarded on June 2018

Advisor: **Tomasz Winiarski**

M.Węgierek

*Agentowa specyfikacja systemu sterującego robota manipulacyjnego IRp-6*

Degree awarded on June 2018

Advisor: **Andrzej Zalewski**

A.Skoniacka

*Metody oceny jakości interfejsu użytkownika*

Degree awarded on March 2018

## 5.4 B.Sc. Degrees

Advisor: **Patryk Chaber**

J.Pankiewicz

*Implementacja algorytmu regulacji predykcyjnej na mikrokontrolerze do sterowania dźwigiem*

Degree awarded on February 2018 (with honors)

P.Kuc

*Implementacja algorytmu regulacji predykcyjnej na mikrokontrolerze do sterowania serwo-mechanizmem*

Degree awarded on June 2018

Advisor: **Paweł Domański**

K.Sobolewski

*Niestabilne regulatory*

Degree awarded on February 2018

M.Lenard

*Symulacja emocji w procesie ewolucyjnym*

Degree awarded on February 2018

Advisor: **Janusz Granat**

M.Jarzynka

*Wykorzystanie baz NoSQL w hurtowniach danych*

Degree awarded on September 2018

Advisor: **Jerzy Gustowski**

K.Staszkiwicz

*Hierarchiczna sieć urządzeń HMI do nadzorowania procesy przemysłowego*

Degree awarded on February 2018 (with honors)

C.Makarski

*Wizualizacja i sterowanie procesami zarządzanymi sterownikami PLC na urządzeniu mobilnym*

Degree awarded on February 2018

R.Rzeuski

*Diagnostyka sterowników programowalnych rodziny SIMATIC*

Degree awarded on February 2018Ł.Śmigielski Systemy eksploracji danych w chmurze – gromadzenie i analiza\* June 2018\*\*

P.Rybak

*Przyjazne środowisko do tworzenia i uruchamiania programów sterujących wyspą zaworową firmy Festo*

Degree awarded on September 2018

C.Modzelewski

*System nadzoru produkcji (SCADA) oparty o chmurę*

Degree awarded on September 2018

Advisor: **Mariusz Kaleta**

M.Citko

*Aplikacja wspierająca optymalną alokację zasobów*

Degree awarded on February 2018

H. Kuczyński

*Aplikacja mobilna do planowania trasy dla kuriera*

Degree awarded on February 2018

Advisor: **Mariusz Kamola**

L.Bondarzewska

*Implementacja usługi sieciowej powiadamiającej o wyjątkowych opóźnieniach w komunikacji miejskiej*

Degree awarded on September 2018

A.Dunajska

*Asystent wyboru OPP*

Degree awarded on September 2018

Advisor: **Andrzej Karbowski**

A.Białobrzeski

*Optymalizacja zdekomponowana metodą równoległego rozkładu zmiennych*

Degree awarded on February 2018

Advisor: **Michał Karpowicz**

S.Bezpalko

*Generator ruchu sieciowego zdefiniowany zbiorem sygnatur systemu IDS Snort*

Degree awarded on February 2018

P.Piotrowski

*Analiza podatności BlueBorne w systemie Android*

Degree awarded on June 2018

Advisor: **Włodzimierz Kasprzak**

D.Lewiński

*Aproksymacja funkcji wyznaczenia atrybutów obiektu*

Degree awarded on September 2018

Advisor: **Kamil Kompa (II)**

J.Kalisiak

*Oprogramowanie do sterownika silnika BLDC realizujące algorytm FOC*

Degree awarded on February 2018

Advisor: **Jakub Koperwas (II)**

M.Stefańczuk

*Aplikacja z wykorzystaniem cyfrowego przetwarzania obrazów-rozpoznawanie znaków drogowych*

Degree awarded on February 2018

Advisor: **Henryk Kowalski (II)**

K.Drożdżał

*Telemetryczny system kontroli działający z chmurą obliczeniową*

Degree awarded on March 2018

Advisor: **Adam Kozakiewicz**

K.Andrusiak

*Domowy honeypot IoT*

Degree awarded on September 2018

Advisor: **Adam Krzemienowski**

M.Lewicki

*Optymalizacja portfela w warunkach jednoznaczności reprezentowanej zbiorem rozkładów stóp zwrotu aktywów finansowych*

Degree awarded on September 2018

K.Romasevska

*Interfejs użytkownika oparty na wzorcu REST dla system wyboru odpornego portfela inwestycyjnego*

Degree awarded on

Advisor: **Maciej Ławryńczuk**

P.Walczak

*Zastosowanie algorytmu roju do projektowania rozmytego algorytmu regulacji predykcyjnej*

Degree awarded on February 2018

Advisor: **Piotr Marusak**

K.Pasikowski

*Narzędzie programowe wspomagające projektowanie algorytmów regulacji predykcyjnej bazujących na modelach o strukturze Hammersteina*

Degree awarded on February 2018

A.Brzozowski

*Sterowanie windy uwzględniające sytuacje awaryjne z wykorzystaniem sterownika PLC; projekt, implementacja, praktyczna realizacja na stanowisku laboratoryjnym*

Degree awarded on February 2018

Advisor: **Mieczysław Muraszkiewicz (II)**

M.Chrostowski

*Wykorzystanie ChatScriptu do obsługi kwerend generowanych przez chatbota*

Degree awarded on September 2018

Advisor: **Ewa Niewiadomska – Szynekiewicz**

M.Koroś

*Ochrona przed atakami typu Man-In-The-Middle w systemach Internetu Rzeczy*

Degree awarded on February 2018

Advisor: **Włodzimierz Ogryczak**

P.Jakielaszek

*Agregacja i ranking wyników z wielu wyszukiwarek dokumentów*

Degree awarded on February 2018

D.Kuczma

*Optymalizacja portfela z ryzykiem mierzonym wskaźnikiem STARR*

Degree awarded on June 2018

J.Szymanowski

*Wspomaganie wyceny samochodów z wykorzystaniem aktualnych danych rynkowych*

Degree awarded on September 2018

Advisor: **Andrzej Pacut**

K.Stachyra

*Rozpoznawanie podpisu odręcznego on-line na urządzeniach mobilnych*

Degree awarded on February 2018

Advisor: **Piotr Pałka**

M.Wiraszka

*Dostosowanie i implementacja standardów komunikacji FIPA ACL do urządzeń Arduino*

Degree awarded on February 2018

Y.Barodzich

*Opracowanie ontologii i komunikacji dla systemu wieloagentowego do transportu towarów między sklepami*

Degree awarded on February 2018

A.Pawlukiewicz

*Ontologia wspierająca komunikację agentów w fabryce Przemysłu 4.0*

Degree awarded on September 2018

Advisor: **Krzysztof Pieńkosz**

W.Natur

*Metody planowania projektów w warunkach występowania niepewności*

Degree awarded on September 2018

D.Urbanowski

*Algorytmy szeregowania zadań zależnych i częściowo podzielonych*

Degree awarded on September 2018

Advisor: **Sebastian Plamowski**

K.Niedzielewski

*Algorytm RST do regulacji obiektu termicznego*

Degree awarded on February 2018

Advisor: **Andrzej Ratkowski**

T.Zwornicki

*Symulator środowiska IoT*

Degree awarded on February 2018

Advisor: **Przemysław Rokita (II)**

W.Figat

*Optimization of numerical calculations execution time in multiprocessor systems*

Degree awarded on September 2018

Advisor: **Andrzej Stachurski**

T.Jakubczyk

*Minimalizacja odległości płaskiej krzywej zamkniętej generowanej przez 6-parametrową procedurę od obrazu rozproszeniowego Mie'go*

Degree awarded on February 2018

T.Lukashevich

*Selekcja cech za pomocą całkowitoliczbowego programowania kwadratowego*

Degree awarded on February 2018

A.Modzelewski

*Symulacje i generacje schematów organizacji ruchu w skali miasta*

Degree awarded on February 2018

M.Kowalczyk

*Uruchamianie aplikacji z system Windows na tablecie działającym w systemie Android*

Degree awarded on September 2018

T.Bajura

*Optymalizacja kształtu w odtwarzaniu obrazu*

Degree awarded on September 2018

Advisor: **Marcin Szlenk**

P.Masłowski

*Narzędzie do wizualizacji modeli zapisanych w języku Alloy*

Degree awarded on September 2018

Advisor: **Wojciech Szynkiewicz**

K.Lis

*Cyberbezpieczeństwo robotów usługowych*

Degree awarded on February 2018

R.Świątkiewicz

*Symulacja dookólnej bazy mobilnej*

Degree awarded on February 2018

M.Bogusz

*System sterowania robotem mobilnym "MiniRyś"*

Degree awarded on February 2018

M. Lukashevich

*Sieci ad hoc czujników bezprzewodowych*

Degree awarded on February 2018

K.Dziewulska

*Algorytmy uczenia się chwytów nowych obiektów*

Degree awarded on February 2018

A.Szlachetka

*Automatyzacja procesu budowy złożenia w środowisku Siemens NX*

Degree awarded on February 2018

P.Walas

*Nawigacja robota mobilnego w bezpośrednim otoczeniu człowieka*

Degree awarded on June 2018

Advisor: **Tomasz Śliwiński**

A.Szulc

*Wspomaganie pracy komiwojażera za pomocą aplikacji w systemie Android*

Degree awarded on February 2018

M.Bogucki

*Program do planowania pracy agenta terenowego w systemie Android*

Degree awarded on September 2018

Advisor: **Paweł Wawrzyński**

M.Andreyeuski

*Aplikacja na Android umożliwiająca zdalne sterowanie robotem z urządzenia mobilnego*

Degree awarded on February 2018

M.Pilarek

*Sterownik do drona oparty o Raspberry Pi*

Degree awarded on February 2018

K.Gabryjelski

*Szybkie uczenie głębokich sieci neuronowych*

Degree awarded on February 2018

P.Rewerska

*Konwolucyjne sieci neuronowe w rozpoznawaniu numerów domów*

Degree awarded on February 2018

A.Tym

*Efektywna implementacja Deep Q – Learning*

Degree awarded on September 2018

Advisor: **Tomasz Winiarski**

A.Kowalewski

*Adapter do enkoderów SSI z interfejsem EtherCAT oraz system sterowania stanowiskiem badawczym*

Degree awarded on September 2018

D.Giełdowski

*Sterowanie silnikiem skokowym robota MiniRys*

Degree awarded on September 2018

K.Borkowska

*Generacja trajektorii o trapezoidalnym profile prędkości w systemie VelmOS*

Degree awarded on September 2018

Advisor: **Andrzej Zalewski**

M.Tomaszewski

*Nowoczesny editor decyzji architektonicznych wykorzystujących notację MAD 2.0 (Maps of Architectural Decisions) działający na urządzeniach mobilnych wraz z modernizacją notacji*  
Degree awarded on September 2018

K.Kulas

*Automatyczna identyfikacja rozwiązań architektonicznych w oprogramowaniu na wybranej platformie mobilnej*  
Degree awarded on September 2018

Advisor: **Izabela Żółtowska**

M.Trochimiak

*Opracowanie, implementacja i testowanie modelu dynamiki współzależności ceny i popytu na usługi hotelowe*  
Degree awarded on February 2018

## 6 Publications

### 6.1 Scientific or Technical Books

- [B1] M. Bochenek, A. Borkowska, U. Brochwicz, M. Chrzanowski, M. Grewiński, T. J. Kruk, J. Lizut, Z. Polak, A. Rywczyńska, K. Silicki, and A. Wrońska, *Standard bezpieczeństwa online placówek oświatowych. Wydanie II uzupełnione*. Akademia NASK, 2018.
- [B2] K. Tchoń and C. Zieliński, Eds., *Postępy Robotyki*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, 2018, no. 196.

### 6.2 Scientific and Technical Papers in Books and Conference Proceedings

- [P1] M. Azimi, “Effects of facial mood expressions on face biometric recognition system’s reliability,” in *2018 1st International Conference on Advanced Research in Engineering Sciences (ARES)*, 2018, pp. 1–5.
- [P2] M. Azimi and A. Pacut, “The effect of gender-specific facial expressions on face recognition system’s reliability,” in *2018 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR)*. IEEEXplore, 2018, pp. 1–4.
- [P3] N. R. Busch and A. Zalewski, “Enterprise architecture modifiability analysis,” in *Towards a Synergistic Combination of Research and Practice in Software Engineering*, ser. Studies in Computational Intelligence, P. Kosiuczenko and L. Madeyski, Eds., 2018, vol. 733, pp. 119–134.
- [P4] W. Dudek and W. Szynkiewicz, “Cyberbezpieczeństwo robotów – nowe wyzwania dla zabezpieczeń systemów cyber-fizycznych,” in *Postępy Robotyki*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds., 2018, no. 196, pp. 107–118.
- [P5] P. Domański, S. Golonka, P. Marusak, and B. Moszowski, “Robust and asymmetric assessment of the benefits from improved control – industrial validation,” in *10th IFAC Symposium on Advanced Control of Chemical Processes ADCHEM 2018 Shenyang, China, 25-27 July 2018*, ser. IFAC-PapersOnLine, S. Joe Qin and B. Wayne Bequette, Eds., vol. 51, no. 18. IFAC, 2018, pp. 815–820.
- [P6] K. Dziuba, R. Góra, P. Domański, and M. Ławryńczuk, “Wielokryterialna ocena jakości regulacji procesu wytwarzania amoniaku,” in *I Konferencja Naukowa Innowacje w Przemysle Chemicznym*, A. Zalewska, Ed. Polska Izba Przemysłu Chemicznego, Warszawa, 2018, pp. 80–90.
- [P7] M. Figat and C. Zieliński, “Model agenta upostaciowionego bazujący na hierarchicznej sieci petriego,” in *Postępy Robotyki*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds., 2018, no. 196, pp. 395–394.
- [P8] M. Lechman and A. Stachurski, “Determination of stresses in rc eccentrically compressed members using optimization methods,” in *COMPUTER METHODS IN MECHANICS (CMM2017): Proceedings of the 22nd International Conference on Computer Methods in Mechanics*, J. Podgórski, E. Błazik-Borowa, J. Bec, T. Burczyński, M. Kuczma, J. Latański, and J. Warmiński, Eds., vol. 1922, no. 1. AIP Publishing, 2018, pp. 1–11.
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