Institute of Control and Computation Engineering

2016 Annual Report

Warsaw University of Technology
Faculty of Electronics and Information Technology
Institute of Control and Computation Engineering
Nowowiejska 15/19, 00-665 Warsaw, Poland
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From the Directors

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 automatic control directed the interest of the research staff and students towards computational and algorithmic aspects of automatic 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 Computer Science as well as in Automatic Control and Robotics, both at three levels of education (undergraduate, postgraduate, Ph.D.). It is necessary to point out that the undergraduate and postgraduate courses in Automatic Control and Robotics, which were launched in 2014 and 2013, respectively, are of great interest of the candidates. In particular, considering the whole Warsaw University of Technology (WUT), the undergraduate course twice had the highest average number of applications. We are also 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 Computer Science or in Automatic Control and Robotics. 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 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. There is a growing interest in this form of studies and more than 200 attendees took part in these courses in the 2015/2016 edition.

The Biometrics and Machine Learning Group has been 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 led by prof. Andrzej Pacut is coordinated by WUT while involving also NASK, AGH University of Science and Technology and Polish Platform for Homeland Security. 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. Furthermore, the same 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.

The Complex Systems Group has been involved in the National Centre for Science grant *Energy-aware computer system for HPC computing*. This research project 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 com-

puter hardware. The research objective is to provide contributions to development of future generations of computing and operating systems.

The Robot Programming and Pattern Recognition Group has been involved in a 7th Framework Program project *Robotic Applications for Delivery Smart User Empowering Applications* (RAPP). The partners of the project are: Centre for Research and Technology Hellas (CERTH, Greece) – the coordinator, Aristotle University of Thessaloniki (AUTh, Greece), Institute National de Recherche en Informatique et en Automatique (INRIA, France), WUT (Poland), Sigma Orionis S.A. (France), Ortelio Ltd. (United Kingdom), Idryma Ormylia (Greece) and Fundation Instituto Gerontologico Matia-Ingema (Spain). The project focuses on utilization of cloud computing and robots in the process of social inclusion of people facing exclusion.

The group lead by Dr. Tomasz Traczyk has concluded the R&D project *Digital Document Repository CREDO* (CREDO) within the National Centre for Research and Development program Demonstrator+ and the EU Innovative Economy Operational Programme. The project has been conducted together with the industrial partners: Polish Security Printing Works S.A. – the coordinator and Skytechnology Ltd. The aim of the CREDO project is to design and launch a demonstrative version of a digital repository enabling short- and long-term archiving of large volumes of digital resources. By design the repository is to act both as a secure file storage and as a digital archive providing metadata management and including the resources in archival packages.

In 2016 the Institute organized two scientific conferences. The 14th EUROPT Workshop on Advances in Continuous Optimization, with organizing committee chaired by Dr. Andrzej Stachurski, has attracted almost 90 contributions from all over the world. The one-day-long national meeting *Biometrics 2016* (*Biometria 2016*), organized by Professor Andrzej Pacut, has attracted 22 contributions.

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. In particular, I would like to compliment professor Andrzej Pacut who has received the award for his lifetime achievements from the Rector of WUT. The awards from the Rector of WUT were also given to four other faculty members: professor Włodzimierz Ogryczak (for scientific achievements), Dr. Piotr Arabas, Dr. Mariusz Kamola and Dr. Michał Karpowicz (for teaching achievements). Moreover, I congratulate Dr. Wojciech Szynkiewicz and Dr. Paweł Wawrzyński who received their D.Sc. (habilitation) degrees in 2016. I also congratulate Dr. Andrzej Zalewski on being awarded with the Medal of the Commission of National Education.

It is my pleasure to congratulate Professor Piotr Tatjewski who has been elected a member of the Central Commission for Degrees and Titles in the field of automatic control and robotics for the term 2017–2020 and for the second term as the Associate Dean for Science. Finally, I would like to take the opportunity to express our gratitude to Professor Cezary Zieliński for the two terms of his service as the Director of ICCE and to congratulate him on being elected the Associate Dean for General Affairs.

Włodzimierz Ogryczak

Contents

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1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2016.

1.1 Directors

Professor Włodzimierz Ogryczak, Director
Professor Maciej Ławryńczuk, Deputy Director for Research
Dr. Tomasz Traczyk, Deputy Director for Academic Affairs

1.2 Organization of the Institute

Systems Control Division

Division Head:	Professor K. Malinowski
Professors:	W. Kasprzak, K. Malinowski, E. Niewiadomska-Szynkiewicz, A. Pacut, C. Zieliński
Professors, retired:	W. Findeisen, R. Ładziński, J. Szymanowski
Assistant Professors:	P. Arabas, A. Czajka, M. Kamola, A. Karbowski, M. Karpowicz, T. Kornuta, A. Kozakiewicz, T.J. Kruk, J. Putz-Leszczyńska, W. Szynkiewicz, P. Wawrzyński, T. Winiarski
Software Engineers:	M. Walęcki
Ph.D. Students:	W. Dudek, J. Figat, M. Figat, W. Gutfeter, M. Krzysztoń, K. Lasota, J. Panasiuk, D. Seredyński, B. Świstak, M. Stefańczyk, M. Trokielewicz
Technical Support:	K. Banachowicz

Research of the division is conducted in 3 research groups:

Complex Systems Group (**E. Niewiadomska-Szynkiewicz**, P. Arabas, K. Lasota, 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**, A. Czajka, W. Gutfeter, J. Panasiuk, J. Putz-Leszczyńska, M. Trokielewicz, P. Wawrzyński)

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 and Pattern Recognition Group (**C. Zieliński**, K. Banachowicz, W. Dudek, J. Figat, M. Figat, W. Kasprzak, T. Kornuta, D. Seredyński, M. Stefańczyk, W. Szynkiewicz, B. Świstak, T. Winiarski)

Research of the group is concerned with robot motion planning and control systems, autonomous mobile robot localization and navigation, robot programming methods, computer vision systems and speach recognition systems. In the robot control systems area research is focused on new motion and force/position control algorithms for multi-robot systems. Special emphasis is given to the sensor-based motion planning and control of single and multiple articulated or mobile robots. In the computer vision and signal processing (speech analysis) area the research is concentrated on autonomous navigation, transportation and security relevant environments. All of this research is centered around service robots, i.e. two-handed devices using visual servoing, force control, and speech recognition to fulfill tasks that humans usually execute.

Control and Software Engineering Division

Division Head:	Professor P. Tatjewski
Professors:	M. Ławryńczuk, K. Sacha, P. Tatjewski
Assistant Professors:	P. Domański, P. Marusak, S. Plamowski, A. Ratkowski, M. Szlenk, A. Zalewski
Senior Lecturers:	J. Gustowski
Senior Engineer:	W. Macewicz
Ph.D. Students:	P. Chaber, K. Czerwiński, A. Hurkała, M. Wasilewski, A. Wojtulewicz, A. Wysocki

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, A. Wysocki)

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**, A. Hurkała, W. Macewicz, K. Sacha, M. Szlenk, A. Ratkowski, M. Wasilewski)

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

Operations and Systems Research Division

Division Head:	Professor E. Toczyłowski
Professors:	W. Ogryczak, E. Toczyłowski
Professors, retired:	W. Traczyk, A. P. Wierzbicki
Readers:	T. Traczyk
Assistant Professors:	J. Granat, M. Kaleta, B. Kozłowski, A. Krzemienowski, P. Pałka, K. Pieńkosz, G. Płoszajski, A. Stachurski, T. Śliwiński, I. Żółtowska
Senior Lecturer:	J. Sobczyk
Ph.D. Students:	J. Hurkała, T. Jastrzębski, A. Mościcka, G. Zalewski

Research of the division is conducted in 2 research groups:

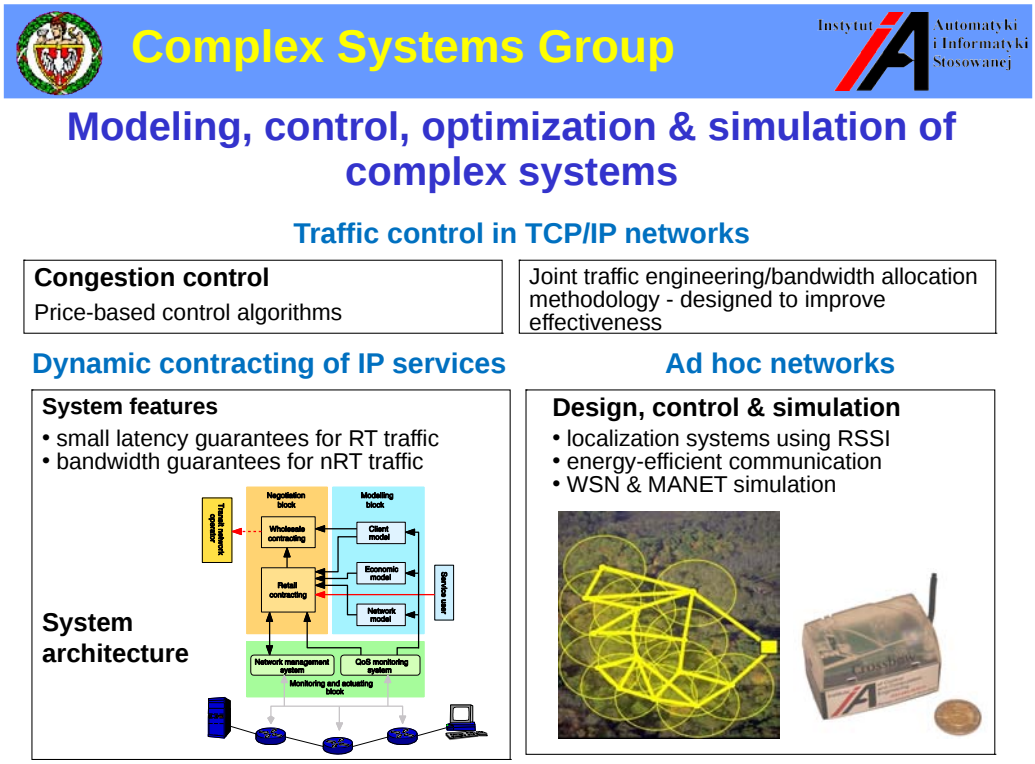
Operations Research and Management Systems Group (**E. Toczyłowski**, M. Kaleta, P. Pałka, K. Pieńkosz, G. Płoszajski, T. Traczyk, I. Żółtowska)

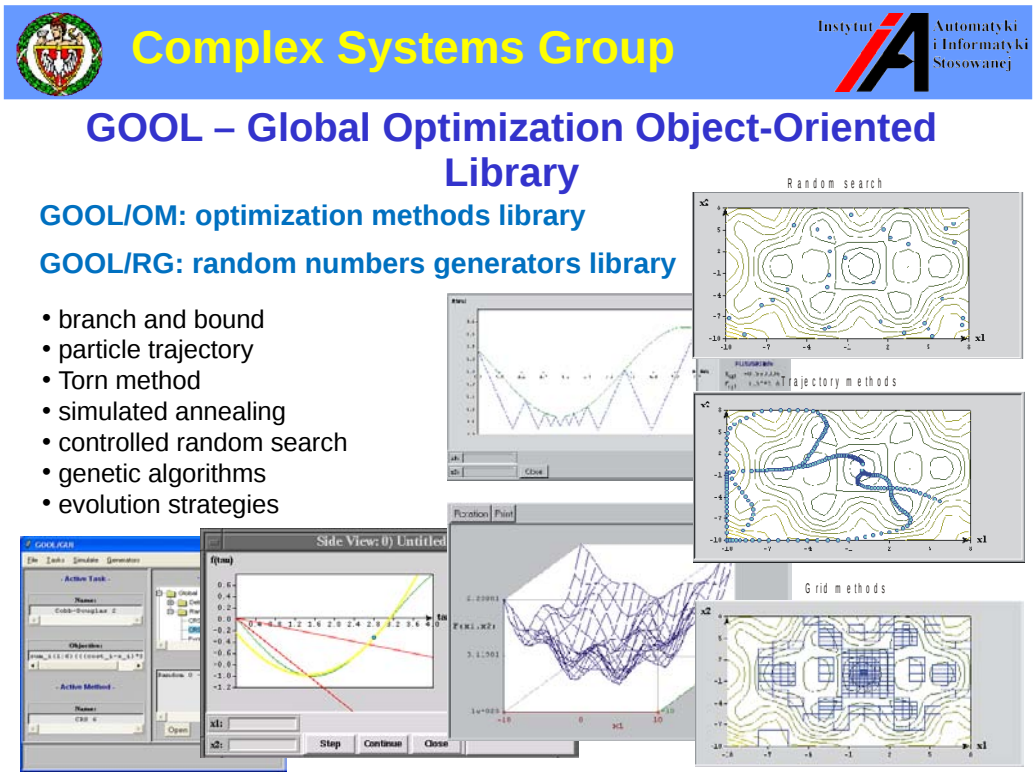
Research of the group is concerned with operation research and structural discrete optimization methods for control and management of discrete processes, including applications in the network structure development, deregulated electric power industry, IP networks, computer integrated manufacturing, etc. 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, J. Hurkała, 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 Research Areas





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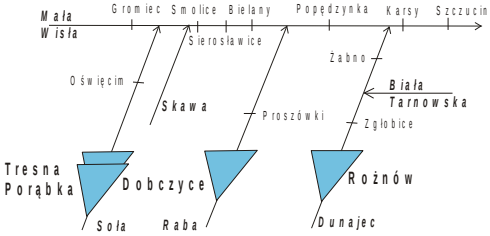
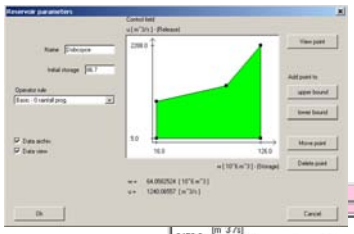
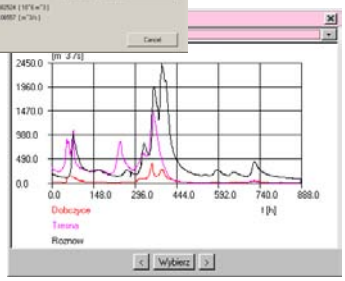
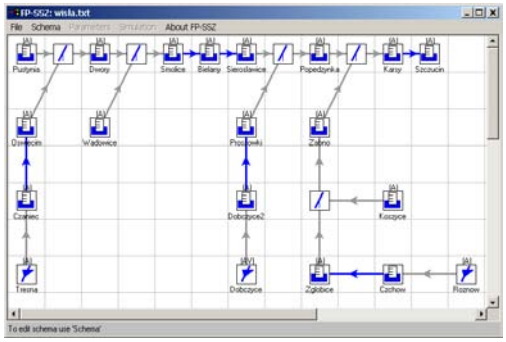
Flood Control

- **FP-SOZ: Flood Control – Reservoir Operation System**
- **FP-SGW: Flood Control – Upper Vistula System**









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Parallel and distributed computations

New software tools:

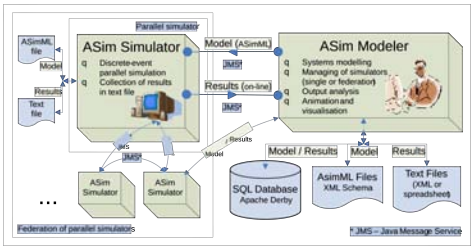
jPar – software environment for parallelizing Matlab calculations

parAMPL – library for parallelizing AMPL calculations

AsimJava – library for parallel simulation of dicrete event systems

MobAsim – software environment for ad hoc network simulation

- parallel optimization algorithms
- parallel and distributed simulation
- new software tools for parallel and distributed computations
- monographs published in 2001 & 2009



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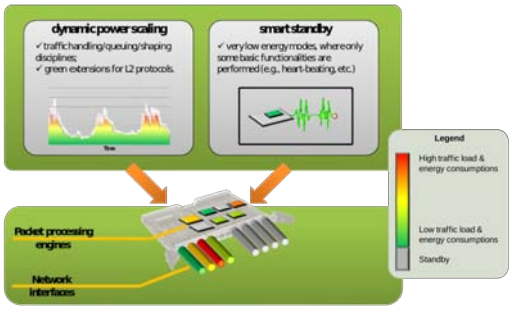
low Energy Consumption NETwork

ECO net

7 Frame Programme UE grant
ICT-2009.1.1: The Network of the Future

The ECONET project aims at introducing:

- novel network-specific HW/FW technologies to optimize the power management features
- local and distributed frameworks for dynamic optimization of the trade-off between energy consumption and network performance
- Green Abstraction Layer for interfacing the novel low-level green capabilities
- novel energy-aware device prototypes



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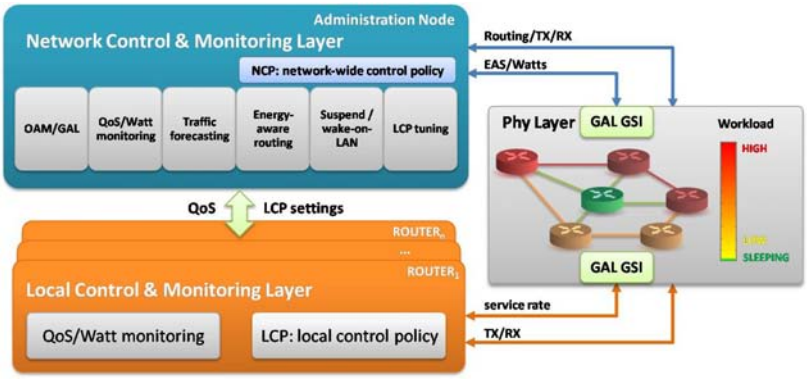
ECO net

low Energy Consumption NETwork

System architecture

- GAL – Green Abstraction Layer – ETSI standardised network devices energy management interface
- NCP – energy-aware traffic engineering
- LCP – node energy aware control



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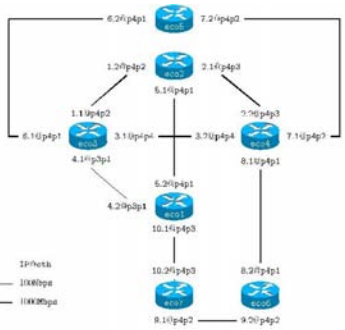
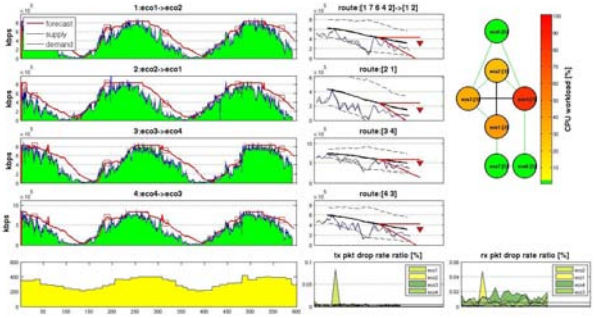
ECO net

Testbed network

- WARMAN metropolitan network topology
- power monitoring system
- local (LCP) nad network (NCP) mechanisms verification





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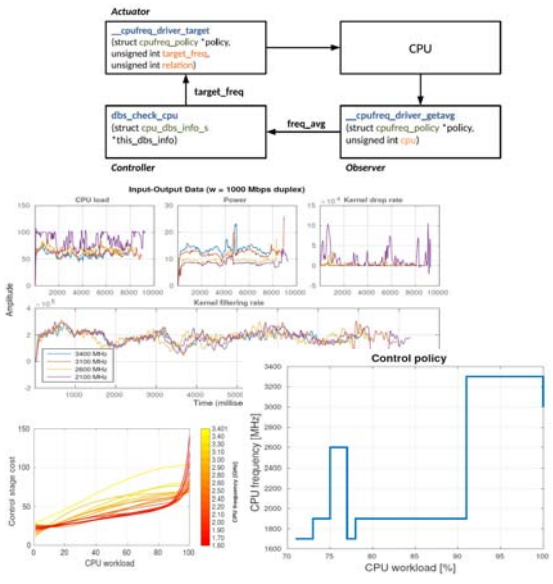
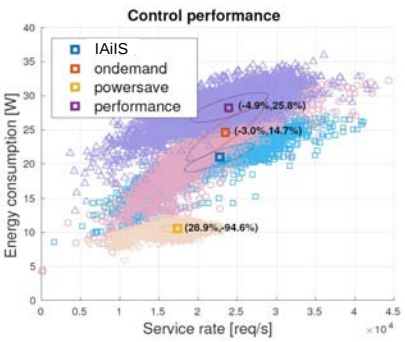
Energy-saving CPU frequency governor



- Application specific power consumption model
- RFC2544-based identification methodology
- Customized frequency scalling governor



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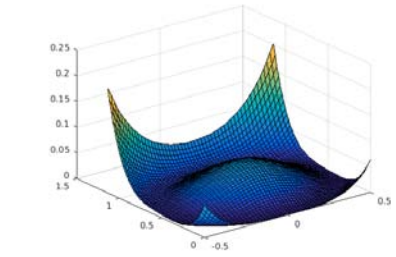
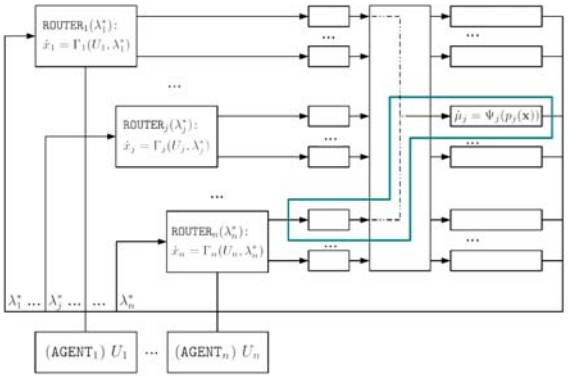
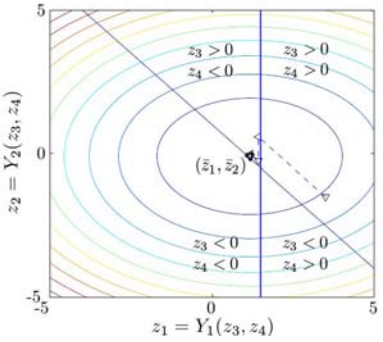
Game theory and mechanisms design

- Nash equilibria design
- Robust TCP/AQM design
- Stability analysis in noncooperative games







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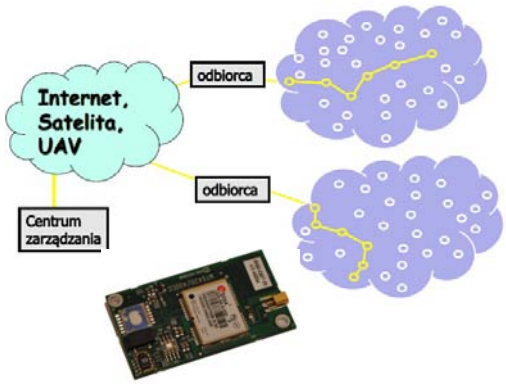
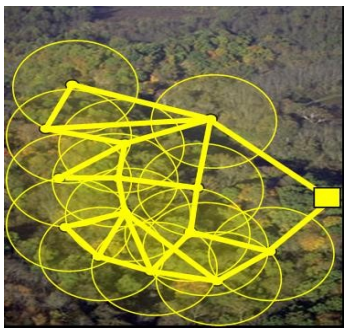
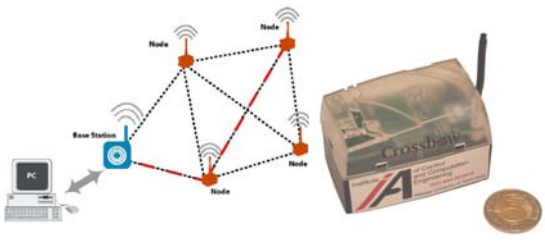
Energy-saving communication in wireless sensor network





- Transmitted signal power control
  Power Control (PC)
- Node activity control
  Activity Control (AC)



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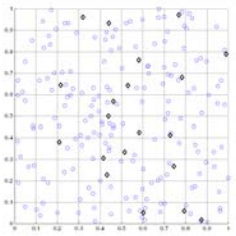
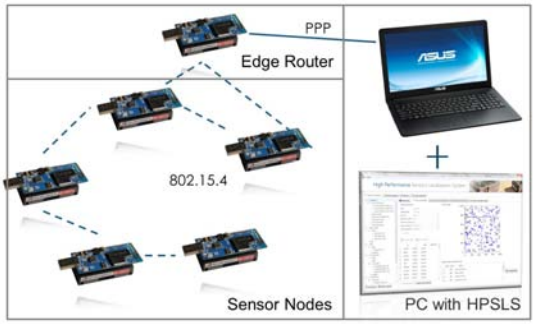
Localization of wireless sensor network nodes

Two phase method

1: Trilateration
2: Stochastic optimization
- Simulated annealing
- Genetic algorithm





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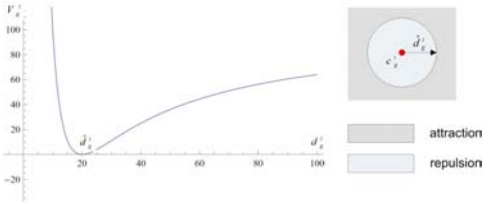
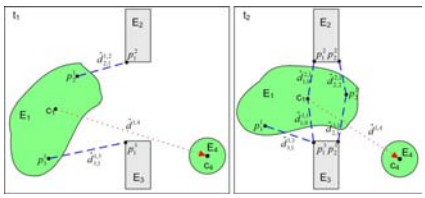
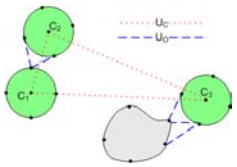
MANET nodes mobility modelling

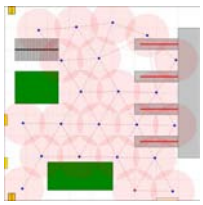
Artificial potential function mobility model

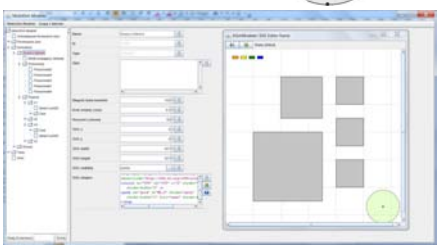






Connected network design
Monitoring nodes location optimization



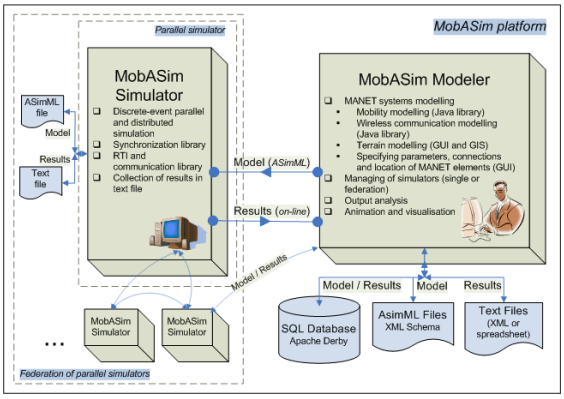


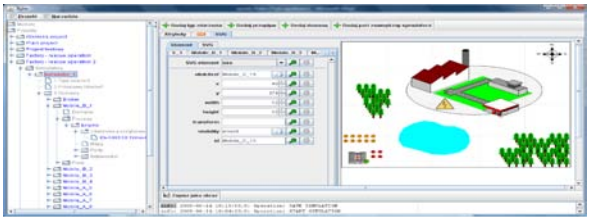
Complex Systems Group

Instytut Automatyki i Informatyki Stosowanej

Asim/Java Simulation Library

- **Complex systems simulation**
- **Technology:**
  - Java
  - distributed
- **Implemented simulators:**
  - Frame Relay network
  - MobAsim – mobile wireless network – IEEE 802.11 b/g
  - WPAN (Wireless Personal Area Network) – IEEE 802.15.4





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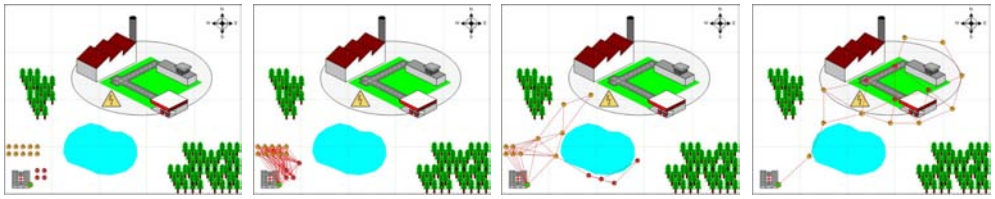
MobAsim

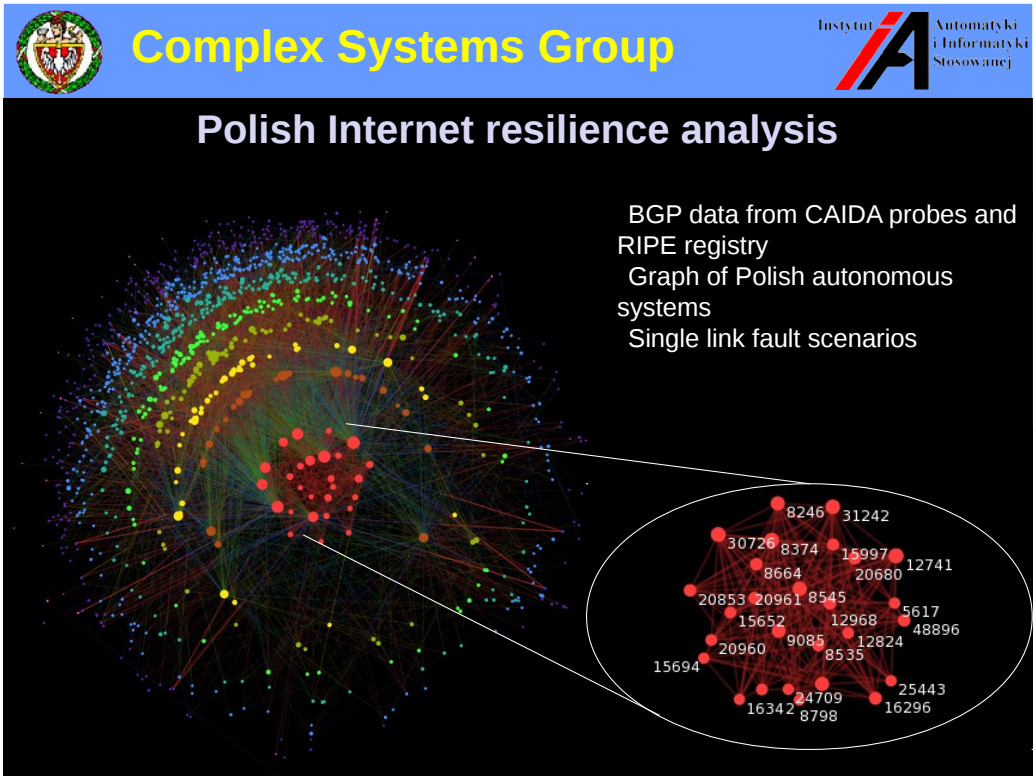
Network simulation

- Library of synchronization routines
- Comunication library for federated simulators

Network modelling

- Wireless transmission and mobility,
- Terrain modelling (SVG/GIS),
- SQL database persistency,
- Distributed management for federated simulators,
- SVG (Scalable Vector Graphics) animations.

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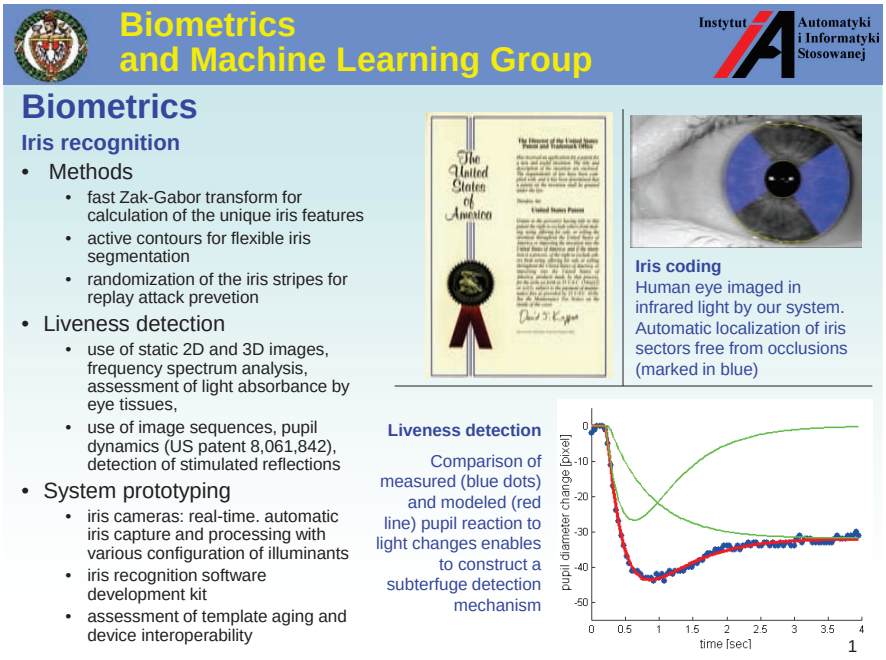
Polish Internet resilience analysis
BGP data from CAIDA probes and RIPE registry
Graph of Polish autonomous systems
Single link fault scenarios
8246
31242
30726
8374
15997
12741
8664
20680
20853
20961
8545
5617
15652
12968
48896
9085
12824
20960
8535
15694
25443
24709
16342
16296
8798


Biometrics
and Machine Learning Group
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Biometrics
Iris recognition
Methods
fast Zak-Gabor transform for calculation of the unique iris features
active contours for flexible iris segmentation
randomization of the iris stripes for replay attack prevetion
Liveness detection
use of static 2D and 3D images, frequency spectrum analysis, assessment of light absorbance by eye tissues,
use of image sequences, pupil dynamics (US patent 8,061,842), detection of stimulated reflections
System prototyping
iris cameras: real-time. automatic iris capture and processing with various configuration of illuminants
iris recognition software development kit
assessment of template aging and device interoperability
Iris coding
Human eye imaged in infrared light by our system. Automatic localization of iris sectors free from occlusions (marked in blue)
Liveness detection
Comparison of measured (blue dots) and modeled (red line) pupil reaction to light changes enables to construct a subterfuge detection mechanism
pupil diameter change [pixel]
time [sec]
1

Biometrics and Machine Learning Group

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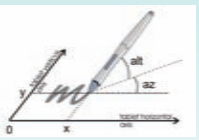
Biometrics

Handwritten signature-based identity verification

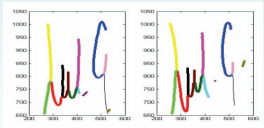
Verification of dynamic signatures (on-line)

- Recognition based on handwriting dynamics [x–velocity, y-velocity, pressure]
- Use of neural networks, dynamic time warping and Hidden Markov Models for verification



Verification of scanned signatures (off-line)

- Integration of several independent methods of verification in a two stage classifier with a global classifier at the second stage
- Use of morphological, texture and grid features
- Time order recovery

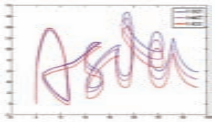


Template creation improvements:

- ***Hidden signature*** – an „artificial" signature which minimizes mean dissimilarity between itself and the signatures from the training set.
- ***Universal forgery features:*** hypothetical ability of the global classifier to classify a signature as a genuine or forgery without knowing the signature template and its owner.

Template ageing:

- Signature template ageing analysis
- Minimization of the impact of template ageing



2

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Biometrics

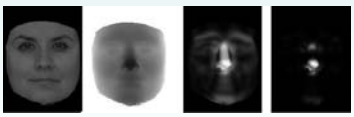
2D and 3D processing techniques for face verification

Different methods of aquiring spatial face data

- Structural light scanning
- Streaming depth images from Kinect-like depth sensors

Using depth and surface structure data for face recognition

- Adding depth and structure curvature information to 2D face recognition algorithms



Creating and analizing dynamic 3D face database (sequences of depth images)

- Collecting dynamic 3D face database using Kinect (or other depth sensor)
- Methods of analizing live image stream
- Modeling 3D face sequences basing on Hidden Markov Model.

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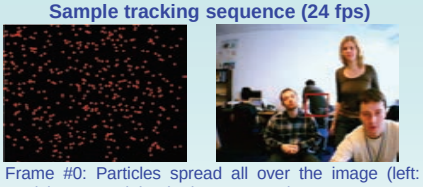
Biometrics

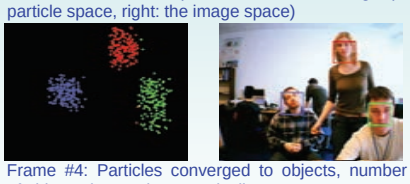
Particle filter-based face tracking and identification

- reference object stored as hue-saturation histogram in the HSV color space
- particle filtering for focus of attention
- „dust"-filtering, based on single pixel classification with fast cluster labelling algorithm for exact tracking
- Bhattacharyya coefficient-based distance measure used to weight particles and „dust"
- automatic detection of the number of objects by Modified X-Means algorithm
- work in progress on gradual information collection for the purpose of identification with increasing confidence level

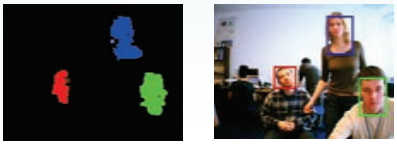
Sample tracking sequence (24 fps)



Frame #0: Particles spread all over the image (left: particle space, right: the image space)



Frame #4: Particles converged to objects, number of objects detected automatically



Frame #4: Dust filtering for exact tracking

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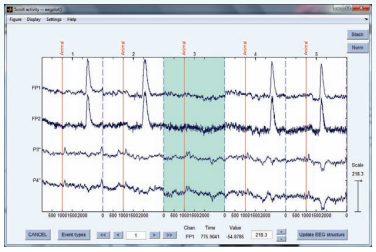
Biometrics

EEG-based identity verification

- Comparison of EEG signals distant in time
  - Short-term variability of EEG
  - Long-term variability of EEG
- Variability of EEG models in different recording conditions
  - Eyes Open/Closed Resting Potentials
  - Visual Enduced Potentials
- Linear and Nonlinear modeling of EEG signal
  - ARMA, ARMAX like models
  - GARCH – Generalized Autoregressive Conditional Heteroskedasticity models
  - Gabor Transform, Wavelet Analysis



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Biometrics

Biometric cryptography

- Exploration of *„biometric spaces"* properties
  - analysis of similarity and dissimilarity measures
  - their relation to the notion of distance and metric properties
- Researchin the possibility of *„biometric embeddings"*
  - embedding biometric spaces with dissimilarities into metric spaces (in particular Euclidean)
- Assessing information capacity of biometric data
  - no model approach based on statistical properties of comparisons
  - model approach based on models for each modality
- Complexity analysis of biometric data
  - inner-structure of codes (dependencies within e.g. iris codes)
- Analysis of aspects of secure implementation of biometric systems

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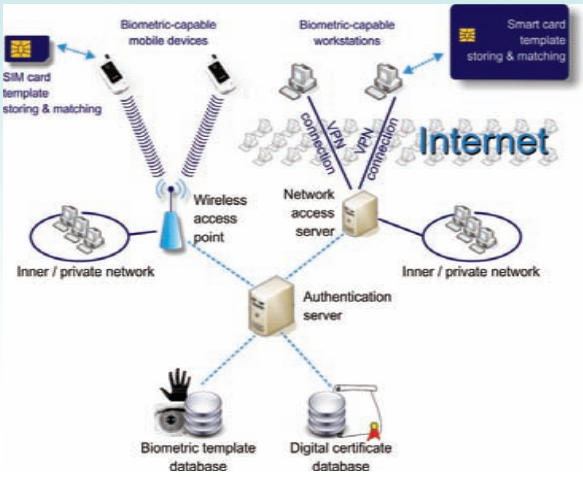
Biometrics

Biometric authentication for secure remote access



- Novel authentication protocols and techniques employing biometrics
- VPN & wireless networks applications
- Development of biometric capable mobile devices and workstations
- Smartcards and SIM cards application for distributed template storage and processing (match-on-token)
- Central template database design and management
- Multiple biometrics (iris, fingerprint and others)

7

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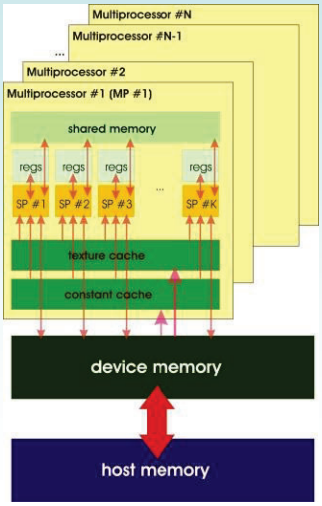
Biometrics

Robust algorithms on GPUs (Graphics Processing Units)

- Iris-based verification and identification system
  - application of NVIDIA CUDA™ technology
  - optimized algorithms for highly parallel biometric template database search
  - using OSIRIS, Daugman and Czajka iris feature coding methods
  - up to 10 mln identities checked per second (100 ns per match) on GeForce GTX285,
  - identification is from 10 to 50 times faster than state-of-art systems
  - identification method based on the best match or on the list of best candidates
  - verification engine capable of performing thousands of verification tasks per second
  - support for encypted biometric template databases



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Robot Programming and Pattern Recognition Group

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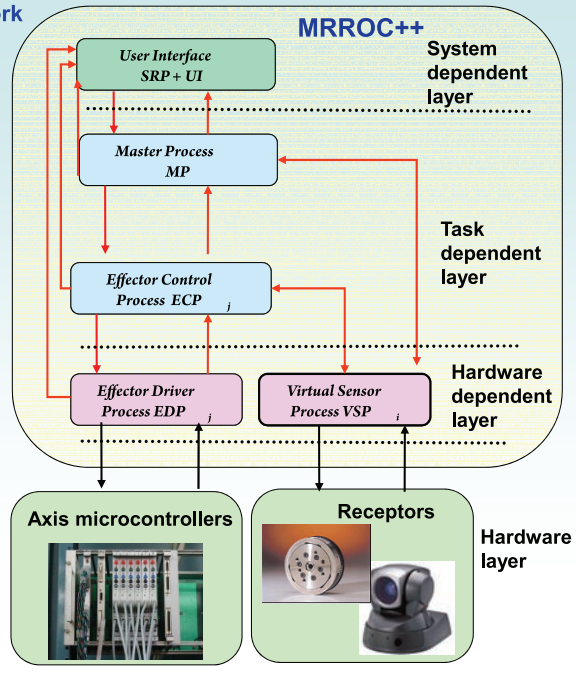
MRROC++ robot programming framework

- a collection of: C++ classes, Linux processes, and a design pattern
- designed for building open modular robot control systems
- distributed within an Ethernet PC network
- Supports dedicated hardware: custom built axis controllers, IMU interfaces
- Cooperates with DisCODe framework

Two co-operating IRp-6 robots



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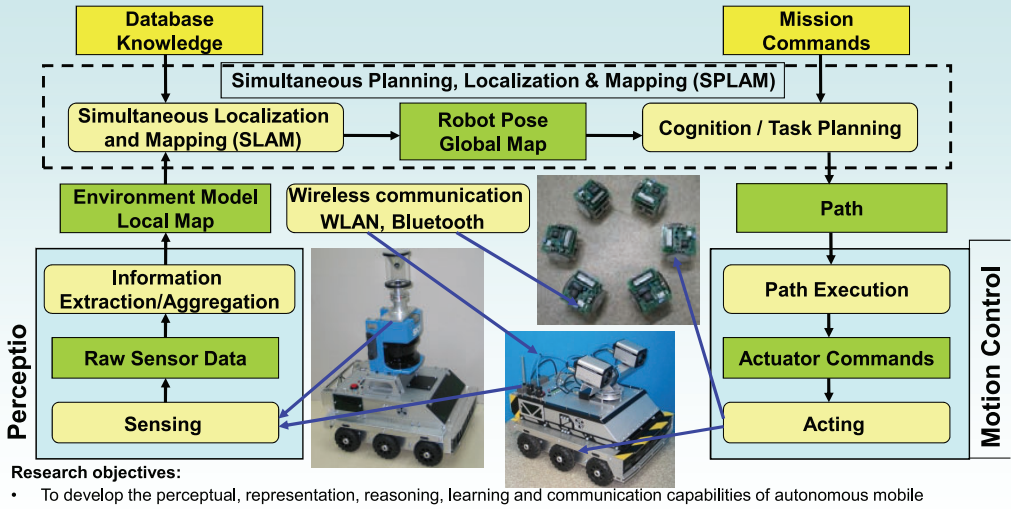
Control architecture for autonomous mobile robot teams



Research objectives:

- To develop the perceptual, representation, reasoning, learning and communication capabilities of autonomous mobile robot systems in human-oriented real-life environments
- To develop and implement a complete, effective, and reusable software for autonomous robot systems that incorporates both programming (manual coding) and learning-derived (automated coding) software composition to increase the ability of autonomous robots to function in unpredictable, dynamic environments
- To study the human-robot interaction (multi-modal interfaces)

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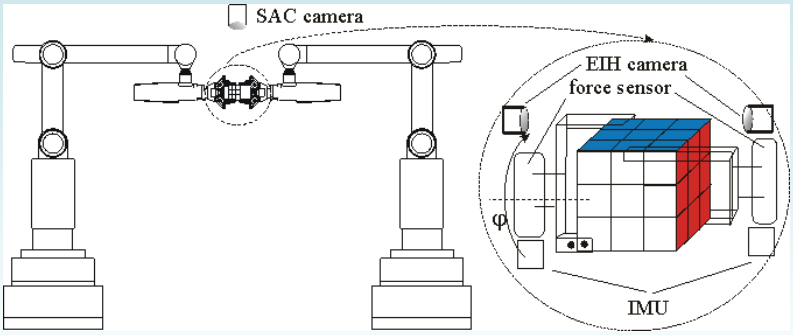
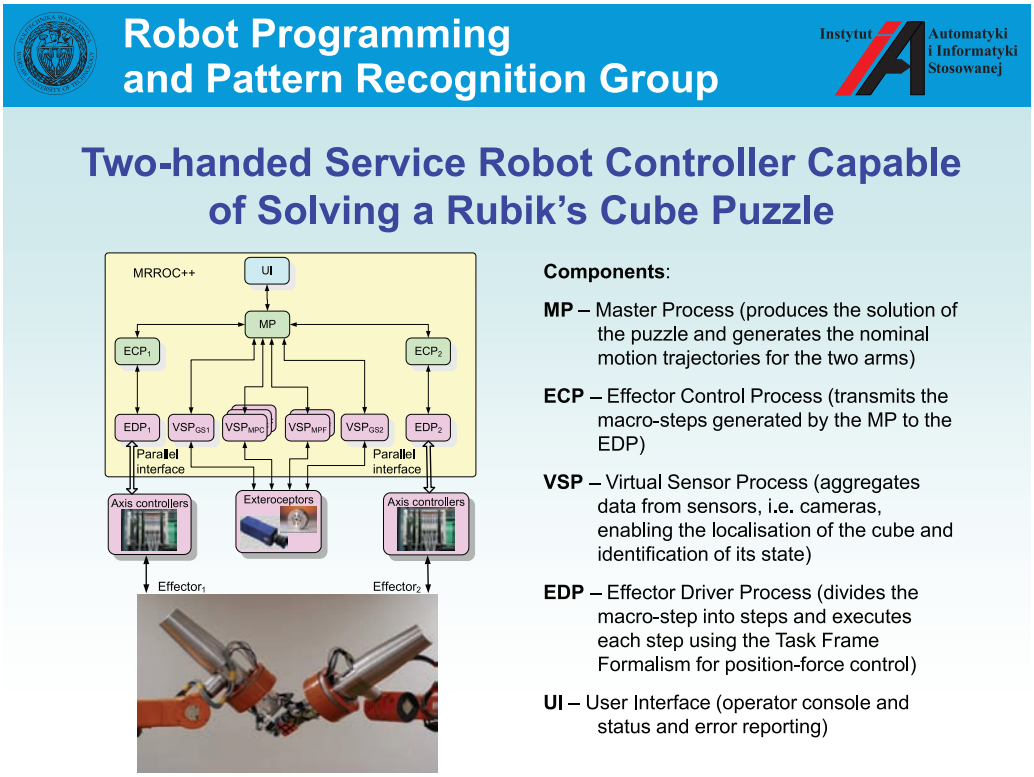
Sensor based two-handed manipulation



Solution of the benchmark task requires:

- **Two-handed manipulation skill to efficiently turn the faces of the cube**
- **Visual sensing capability to locate the cube and identification of its initial state**
- **Visual servomechanism to approach the cube and to get hold of it**
- **Using force sensors supported by inertial measurement units (IMU) to avoid jamming of the cube while rotating the faces**
- **Fusion of deliberative and behavioural control to work out the plan of motions solving the puzzle and to adapt quickly to sudden changes in the environment (e.g., jamming)**
- **Ability to recognize spoken commands and to synthesize replies and queries**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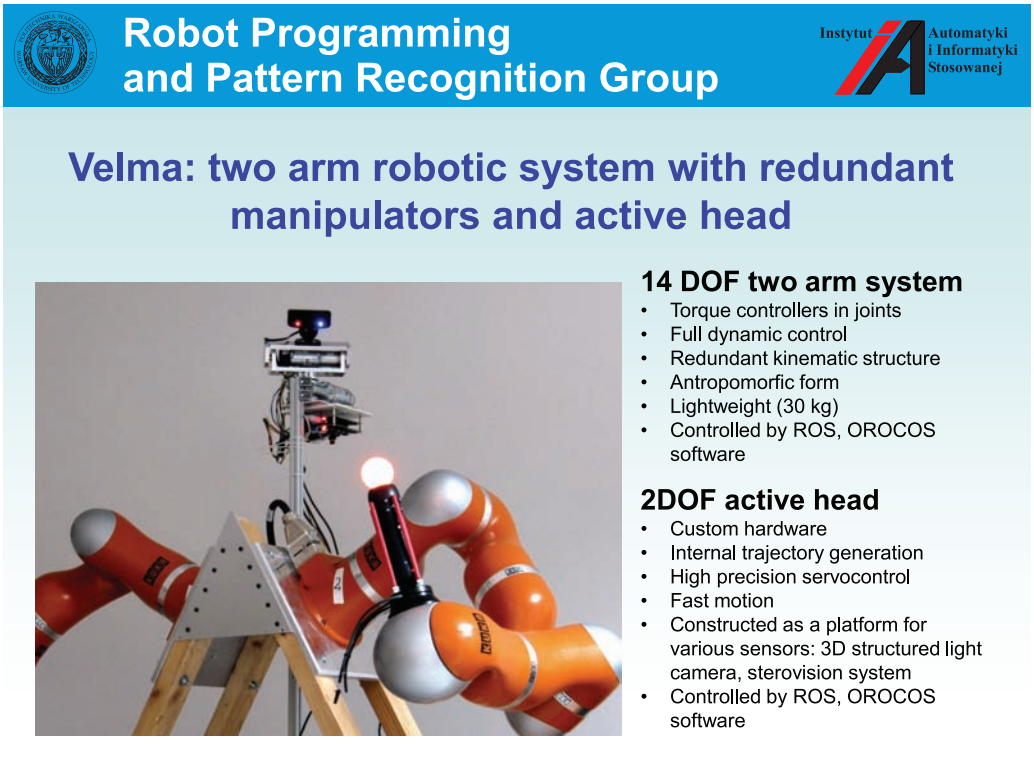
Two-handed Service Robot Controller Capable of Solving a Rubik's Cube Puzzle
MRROC++
UI
MP
ECP1
ECP2
EDP1
VSPGS1
VSPMPC
VSPMPF
VSPGS2
EDP2
Parallel interface
Parallel interface
Axis controllers
Exteroceptors
Axis controllers
Effector1
Effector2
Components:
MP – Master Process (produces the solution of the puzzle and generates the nominal motion trajectories for the two arms)
ECP – Effector Control Process (transmits the macro-steps generated by the MP to the EDP)
VSP – Virtual Sensor Process (aggregates data from sensors, i.e. cameras, enabling the localisation of the cube and identification of its state)
EDP – Effector Driver Process (divides the macro-step into steps and executes each step using the Task Frame Formalism for position-force control)
UI – User Interface (operator console and status and error reporting)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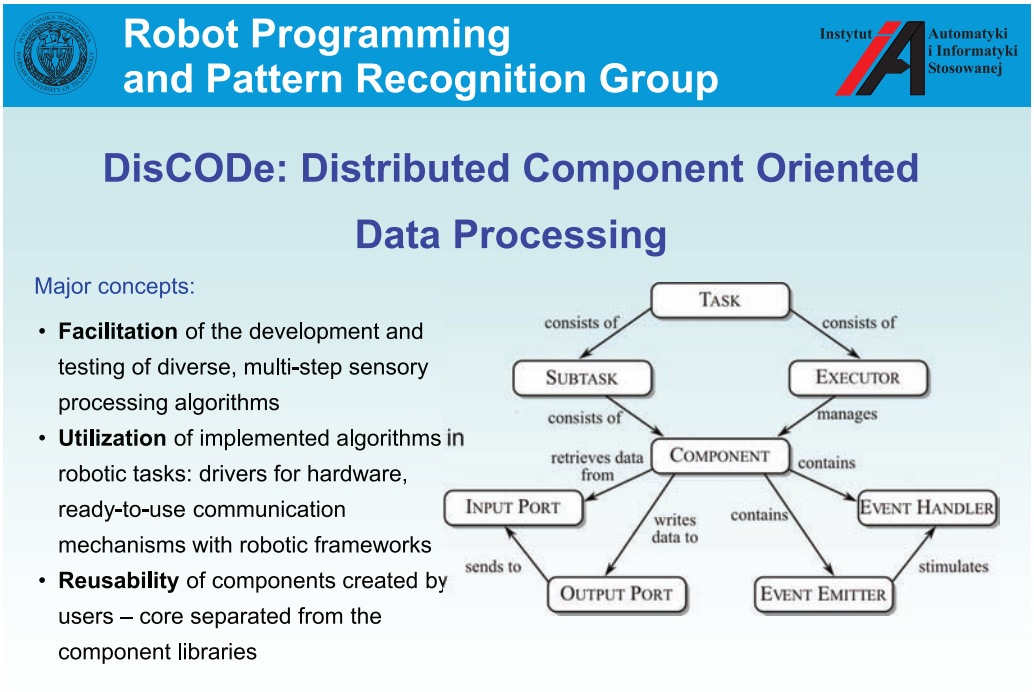
Velma: two arm robotic system with redundant manipulators and active head
14 DOF two arm system
• Torque controllers in joints
• Full dynamic control
• Redundant kinematic structure
• Antropomorfic form
• Lightweight (30 kg)
• Controlled by ROS, OROCOS software
2DOF active head
• Custom hardware
• Internal trajectory generation
• High precision servocontrol
• Fast motion
• Constructed as a platform for various sensors: 3D structured light camera, sterovision system
• Controlled by ROS, OROCOS software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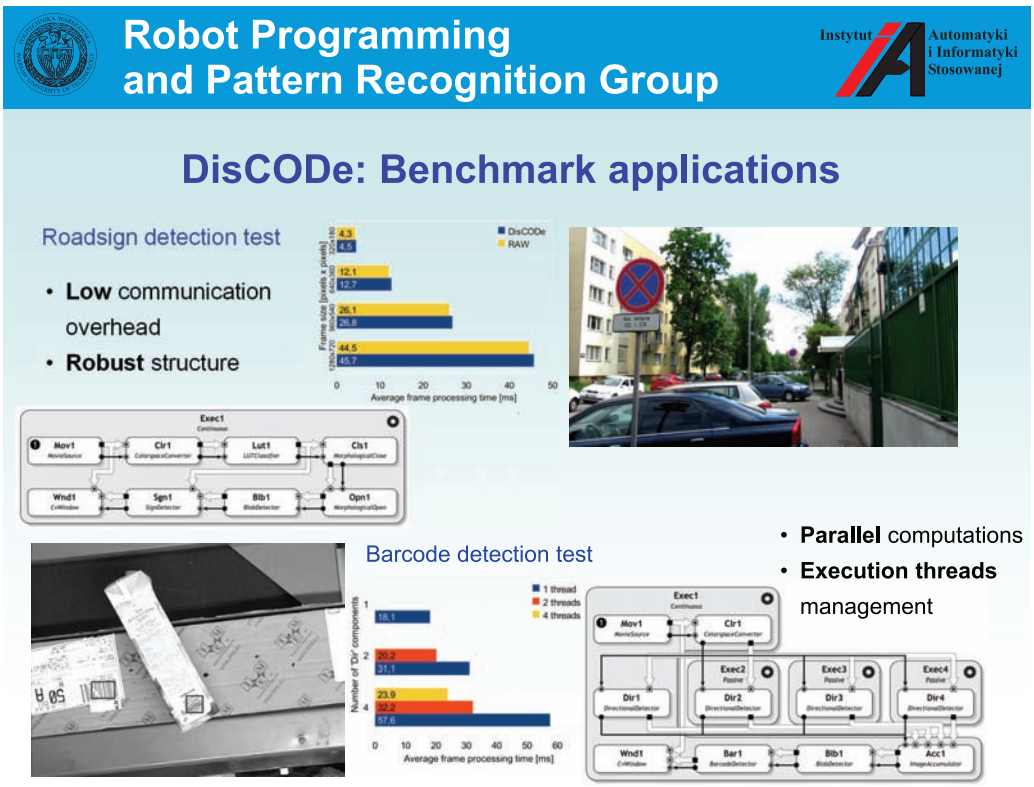
DisCODe: Distributed Component Oriented Data Processing
Major concepts:
• Facilitation of the development and testing of diverse, multi-step sensory processing algorithms
• Utilization of implemented algorithms in robotic tasks: drivers for hardware, ready-to-use communication mechanisms with robotic frameworks
• Reusability of components created by users – core separated from the component libraries
TASK
consists of
consists of
SUBTASK
EXECUTOR
consists of
manages
retrieves data from
COMPONENT
contains
INPUT PORT
writes data to
contains
EVENT HANDLER
sends to
stimulates
OUTPUT PORT
EVENT EMITTER


Robot Programming
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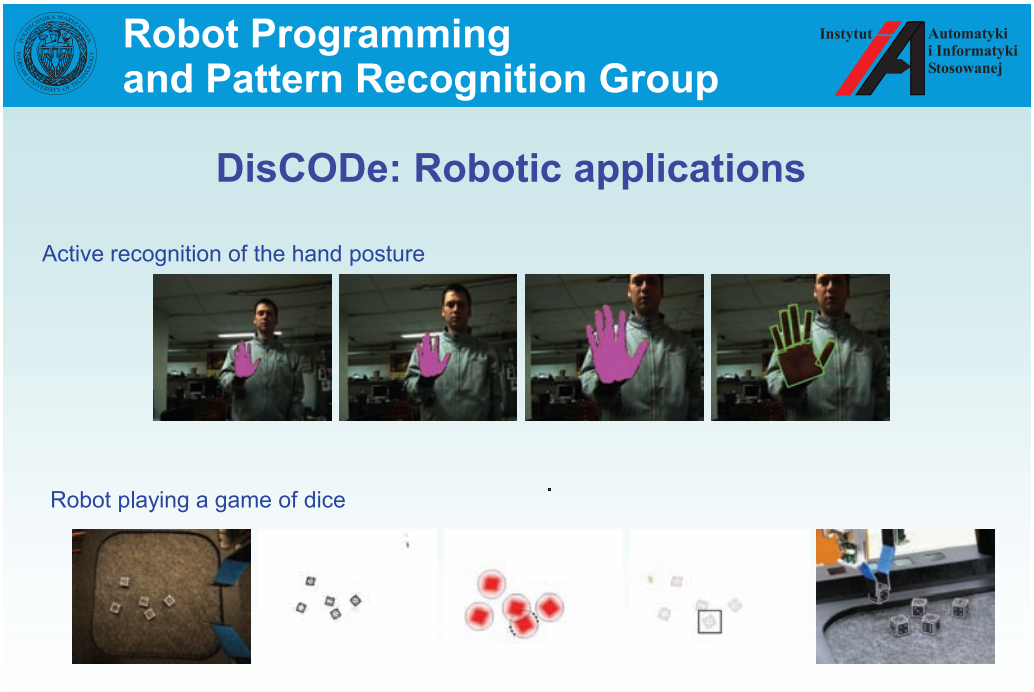
DisCODe: Benchmark applications
Roadsign detection test
• Low communication overhead
• Robust structure
DisCODe
RAW
Average frame processing time [ms]
Barcode detection test
• Parallel computations
• Execution threads management
1 thread
2 threads
4 threads
Average frame processing time [ms]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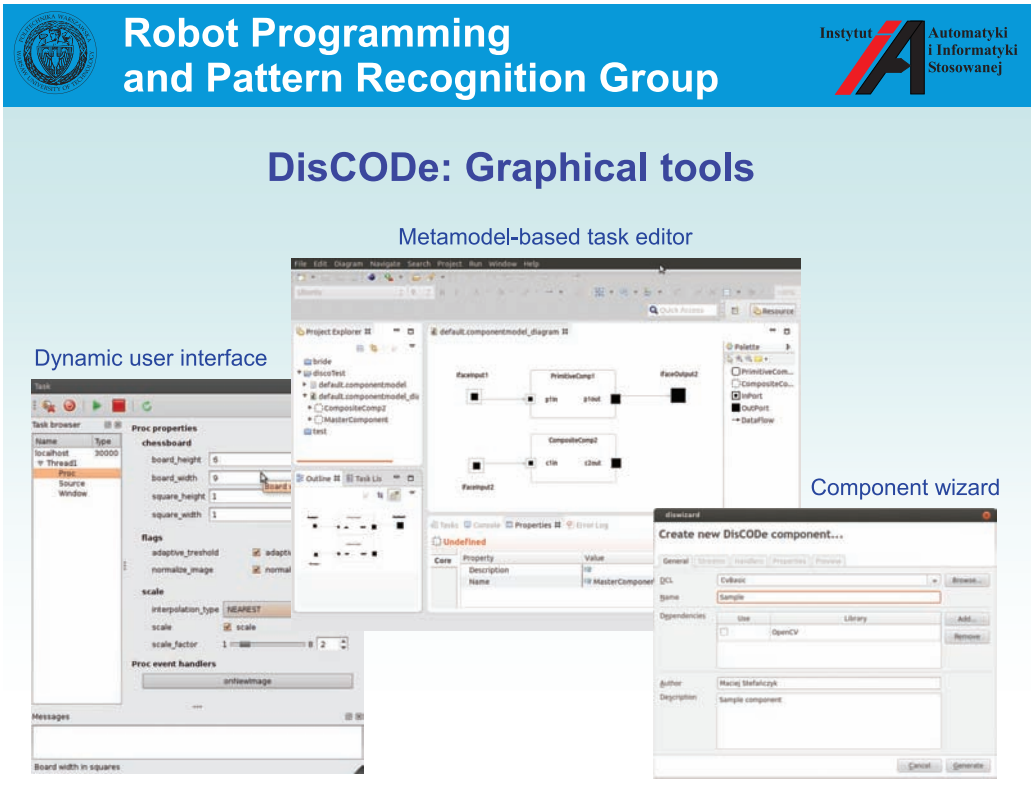
DisCODe: Robotic applications
Active recognition of the hand posture
Robot playing a game of dice


Robot Programming
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DisCODe: Graphical tools
Metamodel-based task editor
Dynamic user interface
Component wizard
Create new DisCODe component...

Robot Programming and Pattern Recognition Group

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Active Perception and Active Vision

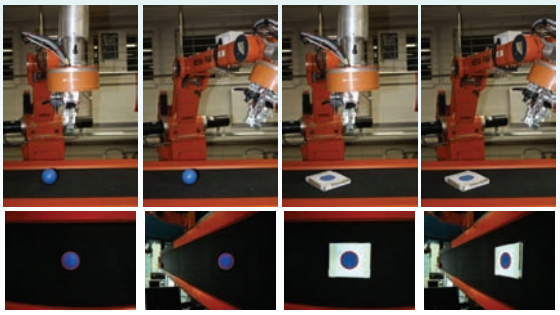
Concept:

Active perception means for a perceptual system to actively seek for the information and not just rely passively on information falling accidentally on the sensor. This also means that the system must be mobile and can interact with the environment.

Active vision:

In the case of a static observer, identification of a distant or partially occluded object can be very difficult and sometimes even impossible. Those problems can be overcomed by the introduction of an active observer, able to perform actions facilitating the gathering and interpretation of perceptual information.

Example: determination of object convexity



Major system concepts:

- **Embodied Agent** based decomposition of the control system into subsystems
- Utilization of **Transition functions** for description of subsystem behaviours
- **Combination** of several behaviours of enabling the successfull realisation of the task

Robot Programming and Pattern Recognition Group

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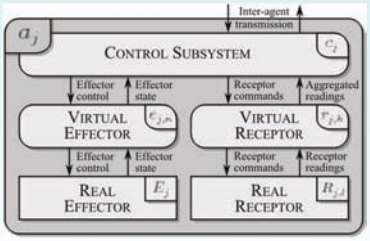
Embodied Agent: a robot control system design method

Concept:

• Design of robot control systems requires a specification method that would facilitate its subsequent implementation.

• The postulated approach bases on decompostion of a system into **Embodied Agents** and description of their **Behaviours** in terms of **Transition Functions**.

Embodied Agent:

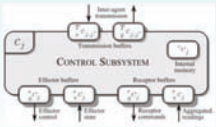


• **Embodied Agent -** any device or program having the ability to perceive its surroundings to subsequently influence the environment state, can communicate with other agents and has an internal imperative to achieve its goal.

Subsystems and transition functions:

• Five types of internal subsystems: its **effector**, **receptor**, **virtual effector**, **virtual receptor** and a **control subsystem**

• The former two form the agent's **corporeal body**, whereas the latter three its **control system**.



•The evolution of the state of each of those subsystems is defined in terms of a transition function, transforming the values taken from input buffers and internal memory into the values written to output buffers (and back to the internal memory as well) and sent subsequently to the associated subsystems.

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Robot Programming and Pattern Recognition Group

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Elementary behaviours of robot manipulators

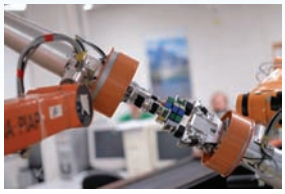
Main concepts:

Three elementary behaviors can be distinguished. They suffice to implement all possible cases of interaction between a manipulator and the environment. Those behaviors are:

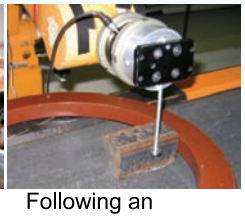
- unconstrained motion with the assumption that no contact with obstacles will be encountered – where pure position control suffices
- contact with the environment – where pure force control is used,
- intermediate or transitional behavior – where initially unconstrained motion is expect to result in eventual contact, or vice versa – for this purpose some form of parallel position–force control has to be utilized (e.g., stiffness, damping or impedance control).

The existing manipulator control can be classified taking into account the proposed behaviors.

In terms of those behaviors complex tasks can be specified formally and implemented.

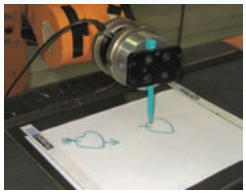


Rubik's cube solver



Following an unknown contour

Rotating a crank



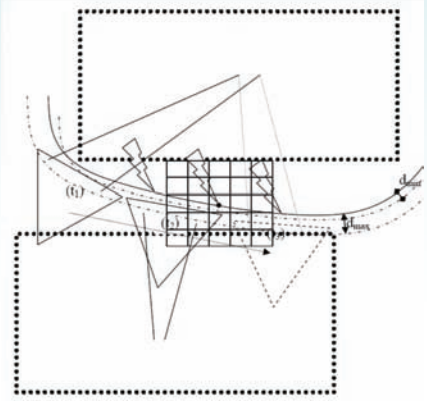
Copying drawings

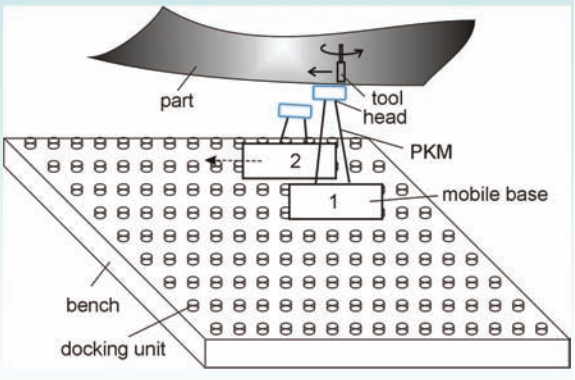
Robot Programming and Pattern Recognition Group

Instytut Automatyki i Informatyki Stosowanej

Programming and control of a swarm of mobile fixtures

Seventh Framework Program
Theme [NMP-2007-3.2-1]
Project: **SwarmItFIX - Self Reconfigurable Intelligent Swarm Fixtures**





Active mobile fixture system for drilling and milling processes:
a bench with docking units, 2 mobile bases with PKM manipulators and heads.

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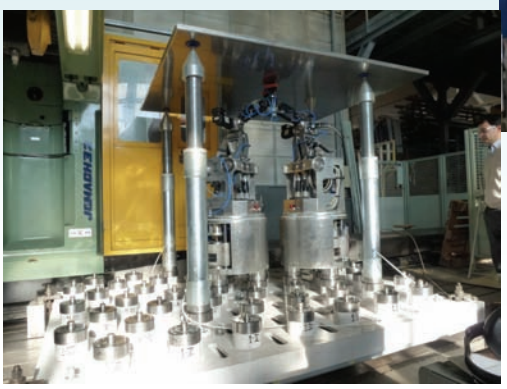
Mobile supports replacing static fixtures

Instead of fixtures manufactured to support a single workpiece, robots can support many shapes, thus making production cost effective.

Standard fixture



The SwarmItFIX system

Project partners:University of Genova,Piaggio Aero, Exechon, ZTS VVU Kosice, Centro Ricerche FIAT, Warsaw University of Technology

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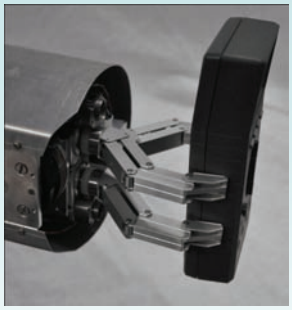
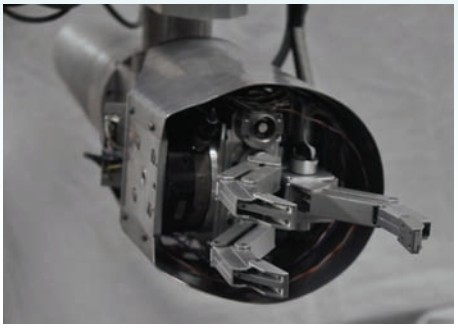
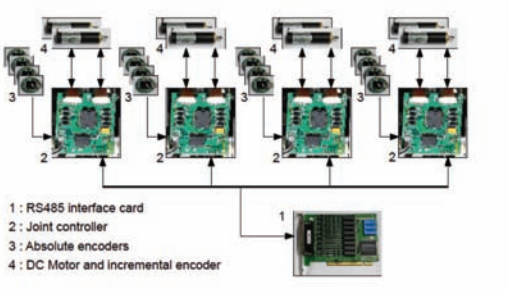
Three finger gripper

- 8 active joints in 3 fingers
- Force sensing in 6 joints
- Force compliance to deal both with hard and soft objects
- Ultra compact motion controllers mounted on board
- Cascade controller with external position/force (torque) control loop and optional, internal current control loop
- RS-485 interface to PC Computer with master controller







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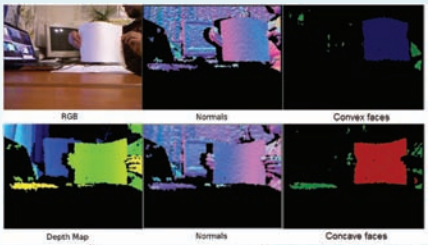
Computer Vision in mobile and service robotics

Environment map generation, obstacle avoidance.

Depth-map and color image Segmentation



3D object recognition

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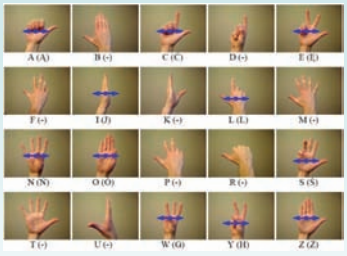
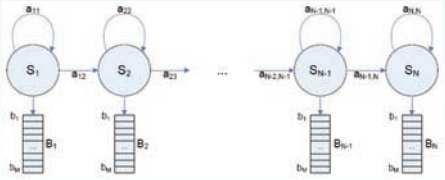
Palm pose and gesture recognition in video sequences

- Palm pose recognition

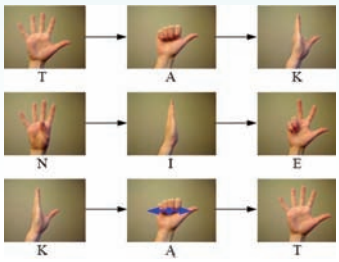
- Static and dynamic („letters”):



- HMM and DBN modelling of pose sequences:



- Examples of gestures („words”):



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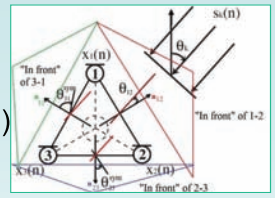
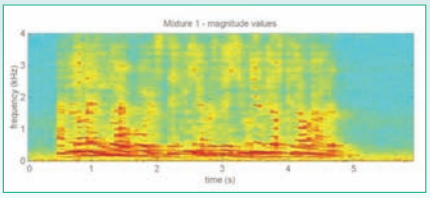
Auditory scene analysis

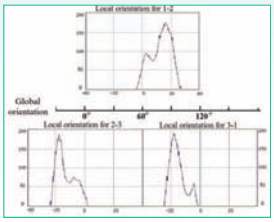


- Only mixtures of source signals can be acquired,
- The goal is to estimate the directions (and locations) of the speakers and to estimate the original sources.

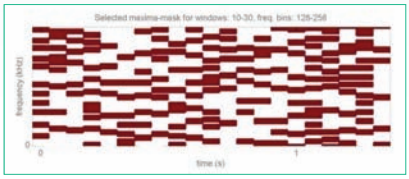


Example:

two sources and three mixtures



Time delay-based detection of source directions:



A spectrogram mask for extraction of a single source

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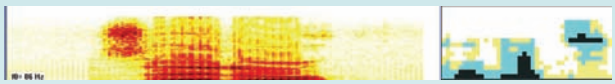
Spoken sentence recognition

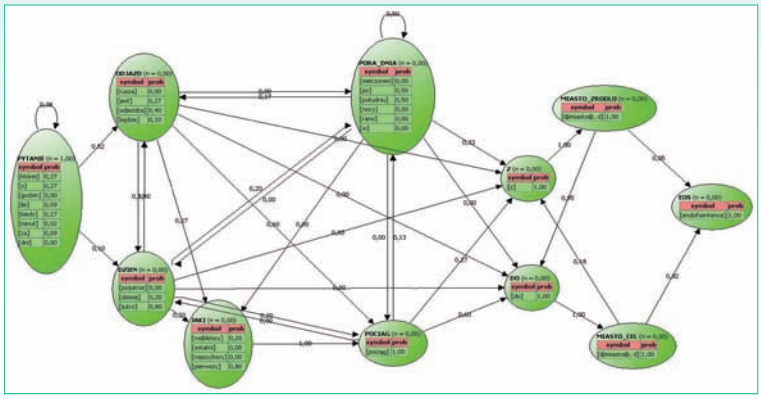
- Spectral analysis
- Acoustic-phonetic features
- Word recognition
- A N-gram language model



$$P(w_i \mid w_{i-N+1} w_{i-N+2} \ldots w_{i-1}) = \frac{C(w_{i-N+1} w_{i-N+2} \ldots w_i)}{C(w_{i-N+1} w_{i-N+2} \ldots w_{i-1})}$$

- HMM-based sentence recognition

Example of a semantic" HMM for the recognition of train connection questions:



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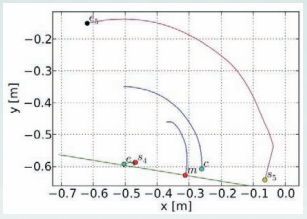
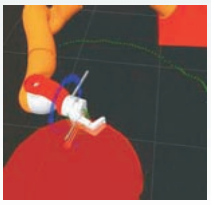
Door opening

- Impedance control of humanoid robot
- Estimation of the door pose based on visual markers
- Tactile sensors on finger tips used for active sensing for better pose estimation
- Unknown door model
- Door parameters (radius, position of the handle) are obtained during the task execution
- Visualisation of the robot state and the environment state

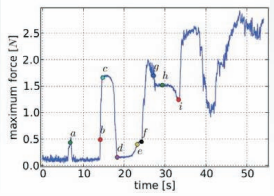
Velma robot opening the door



The plot of measured and commanded trajectories



The visualisation of the robot and environment state



The plot of total force acting on the tactile sensors

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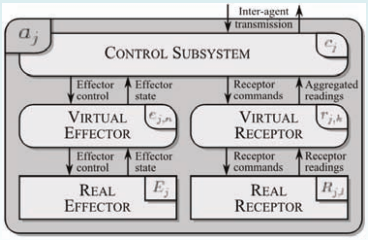
Embodied Agent: a robot control system design method

Concept:

• Design of robot control systems requires a specification method that would facilitate its subsequent implementation.

• The postulated approach bases on decompostion of a system into **Embodied Agents** and description of their **Behaviours** in terms of **Transition Functions**.

Embodied Agent:

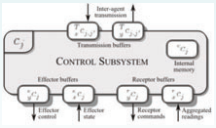


• **Embodied Agent -** anydevice or program having the ability to perceive its surroundings to subsequently influence the environment state, can communicate with other agents and has an internal imperative to achieve its goal.

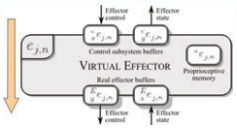
Subsystems and transition functions:

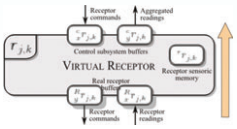
• Five types of internal subsystems: its **effector**, **receptor**, **virtual effector**, **virtual receptor** and a **control subsystem**

• The former two form the agent's **corporeal body**, whereas the latter three its **control system**.



•The evolution of the state of each of those subsystems is defined in terms of a transition function, transforming the values taken from input buffers and internal memory into the values written to output buffers (and back to the internal memory as well) and sent subsequently to the associated subsystems.





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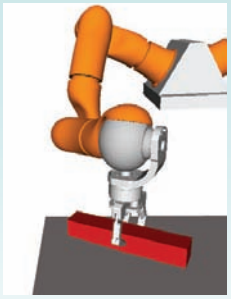
Grasping

- Impedance control of humanoid robot
- Visual markers
- Feedback from tactile sensors used for grasp evaluation
- Full environment model
- Planning collision free motion of the manipulators
- Task oriented grasp planning based on analytical contact forces analysis



Velma robot grasping a cuboid (simulation)

Velma robot grasping a cuboid

The visualisation of tactile sensors readings

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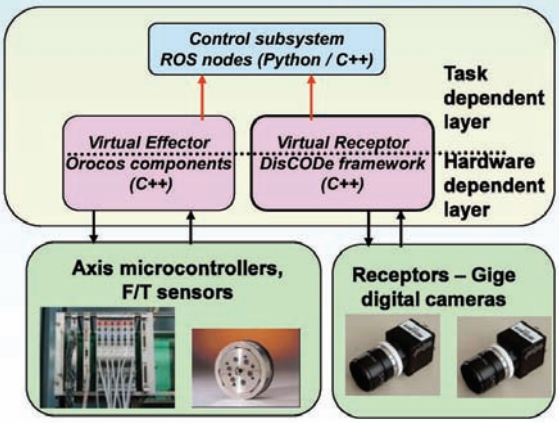
IRPOS robot programming framework

Two co-operating IRp-6 robots

- a collection of: C++ Orocos components, Python/C++ ROS nodes, and an embodied agent inspired design pattern
- designed for building open, modular manipulator control systems
- Supports dedicated hardware: custom built axis controllers, Force/Torque sensors
- Cooperates with DisCODe framework computing a visual data from Gige digital cameras
- Unified, three behavioral Position/force, external space control with inner loop position joint control



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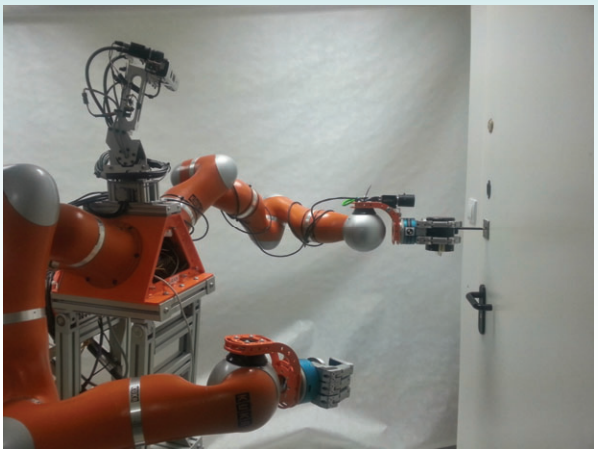
Velma: two arm robotic system with redundant manipulators, grippers, active head and torso



16 DOF two arm system

- Torque controllers in joints
- Full dynamic control
- Redundant kinematic structure
- Antropomorfic form
- 2 DOF active torso
- Controlled by ROS, OROCOS software
- 3 figered barrett hand grippers with tactile sensing

2DOF active head

- Custom hardware
- Internal trajectory generation
- High precision servocontrol
- Fast motion
- Constructed as a platform for various sensors: 3D structured light camera, sterovision system
- Controlled by ROS, OROCOS software

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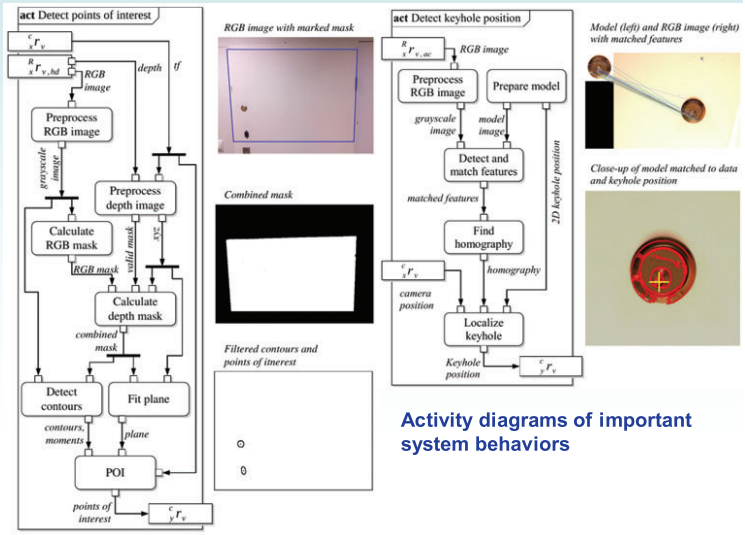
Localization and inspection of door locks

- omprehensive strategy of door locksexamination as a paradigm of active sensing
- nitial region of interestis localized using the RGB-D low resolution camera mounted on the robot head
- tiis theninspected using 2D camera mountedon the robot arm



Activity diagrams of important system behaviors

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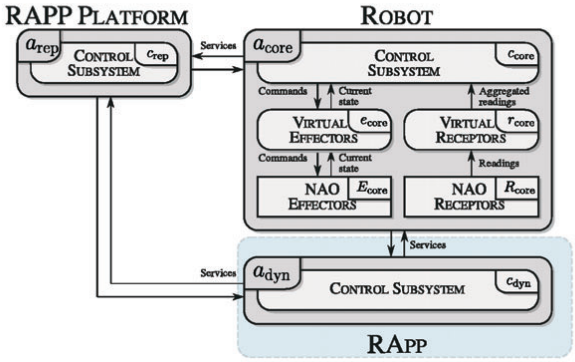
Variable structure robot control system

Robotic Applications for Delivering Smart User Empowering Applications
RAPP: Robots enabling societal inslusion



Observations:

- limited robot controller capabilities
- unlimited capabilities of the cloud

Conclusion:

- downloadable application part
- switchable supervisor

- a_{core} – robot control + system composition (fixed)
- a_{dyn} – user task executor (exchangeable)
- a_{rep} – application software and service provider

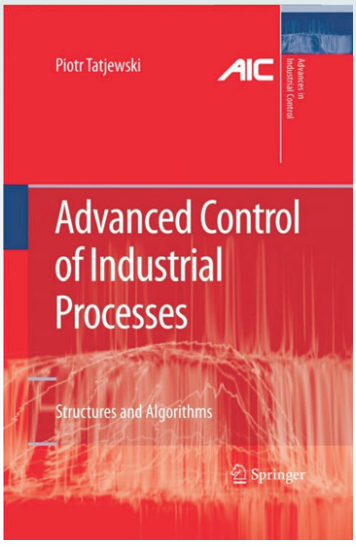
FP7 Collaborative Project RAPP (Grant no 610947), European Commission, 2013–2016

Control Engineering Group

Instytut Automatyki i Informatyki Stosowanej

Advanced control of industrial processes

- Non-linear process modeling using fuzzy logic and neural networks, design of fuzzy controllers
- Algorithms and structures of MPC (Model-based Predictive Control) with linear and nonlinear process models (quick control laws, precise optimization-based algorithms)
- Supervisory control and set-point optimization
- Fault-tolerant control
- Software for development and testing of advanced control systems



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Optimization of industrial processes and large-scale systems

- Algorithms for optimization of steady-states of industrial processes
- On-line measurement-based set-point optimization under uncertainty
- Hierarchical (multilevel) optimization methods for large-scale systems
- Multilevel algorithms for on-line set-point optimization of interconnected processes under uncertainty

Control Engineering Group

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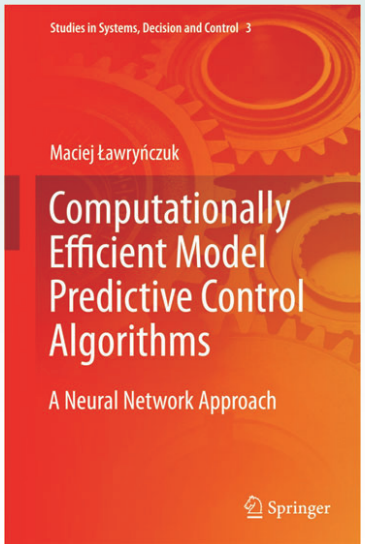
Computationally efficient model predictive control algorithms: a neural network approach

- Thorough presentation of MPC algorithms based on different kinds of neural models
- Comparison of different on-line model and trajectory linearisation techniques
- The MPC algorithms with neural approximation with no on-line linearisation
- The MPC algorithms with guaranteed stability and robustness
- Cooperation between the MPC algorithms and set-point optimisation



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DiaSter (Diagnostics and Control) software system (co-authors)

- Model building and identification (linear and nonlinear models, including fuzzy and neural)
- Diagnostics
- Design of classical control algorithms (PID)
- Design of advanced control algorithms (fuzzy, MPC)
- Development of set-point optimization
- Simulation

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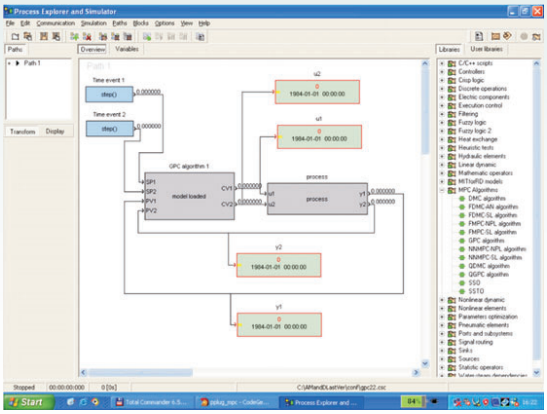
DiaSter (Diagnostic and Control) software system

Model Predictive Control (MPC) algorithms based on *linear models*:

- Dynamic Matrix Control (DMC) algorithm based on step-response models
- Generalized Predictive Control (GPC) algorithm based on input-output models



Two version of DMC and GPC algorithms:

- *Explicit algorithms*: the control law is designed off-line
- *Numerical algorithms*: on-line control optimization based on quadratic programming is used

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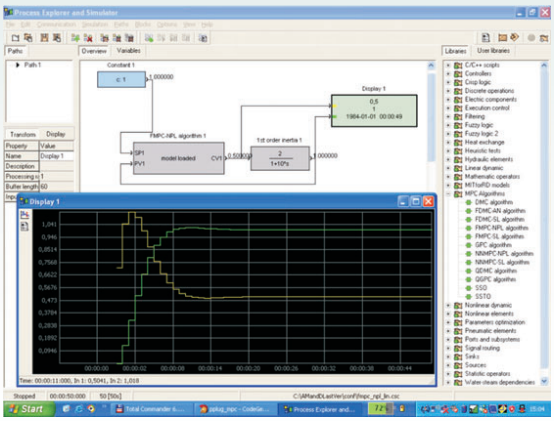
DiaSter (Diagnostic and Control) software system

Model Predictive Control (MPC) algorithms based on *nonlinear models*:

- MPC algorithm with on-line Successive Linearization (MPC-SL)
- MPC algorithm with on-line Nonlinear Prediction and Linearization (MPC-NPL)



- The MPC algorithms are *computationally efficient* because quadratic programming is used on-line rather than difficult nonlinear optimization
- Neural and fuzzy models can be used for prediction

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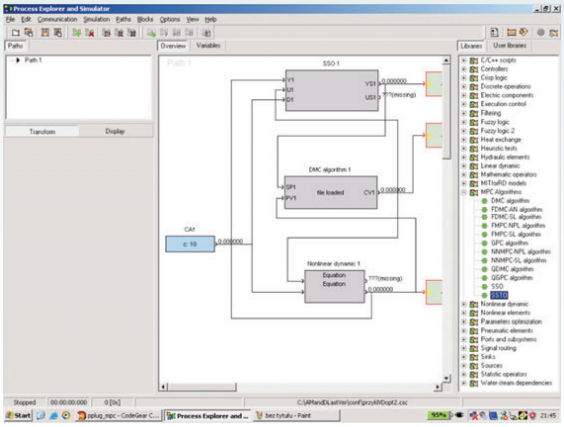
DiaSter (Diagnostic and Control) software system

Set-point optimization structures which cooperate with MPC algorithms:

- Steady-State Optimization structure
- Steady-State Target Optimization structure with on-line model linearization



The set-point optimization structures are *computationally efficient* because linear programming is used on-line rather than difficult nonlinear optimization

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R&D project: MPC Controller for the burning process in small furnaces used for house/water heating

- Benefits of advanced control algorithms (MPC – Model-based Predictive Control):
  - Good control accuracy
  - High process efficiency
  - Increase of economic profits
  - Ecology - the process is friendly for the environment
- The controller is on the market (manufactured by ***Plum*** company)

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R&D project: The anti-smoke ventilation control in high buildings

The fire smoke is most dangerous: to save people air pressure and flow must be quickly controlled in rescue areas – highly demanding nonlinear feedback control problem

Classical PID control unable to fulfill the requirements

Nonlinear MPC algorithm with **on-line model adaptation** designed, featuring:

- computational efficiency (quadratic programming is used on-line)
- very fast operation
- control accuracy satisfying demanding requirements

Therefore: increase of fire safety

The controller is on the market (manufactured by ***Plum*** company)

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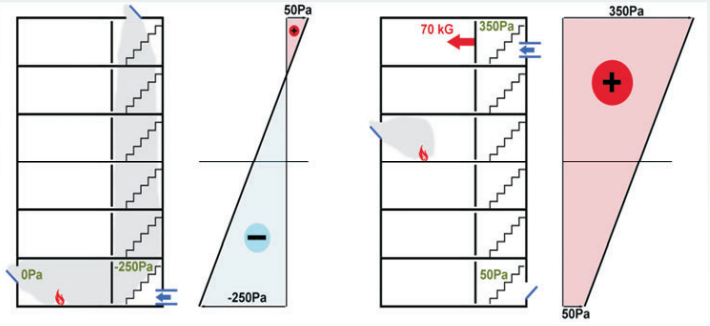
Instytut Automatyki i Informatyki Stosowanej

R&D project: The anti-smoke ventilation control in high buildings

In high buildings the anti-smoke control is much more difficult due to chimney effect – multivariable control with two actuators (high power ventilators) required



Nonlinear MPC algorithm with **on-line model adaptation** designed (the controller is manufactured by ***Plum*** company)

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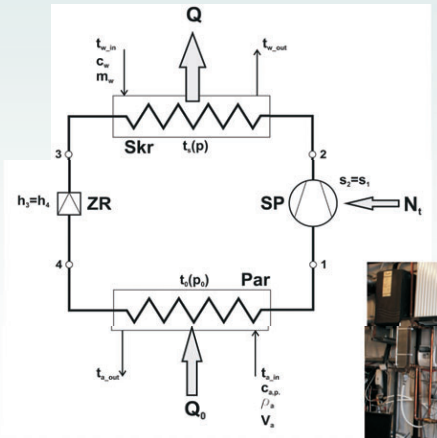
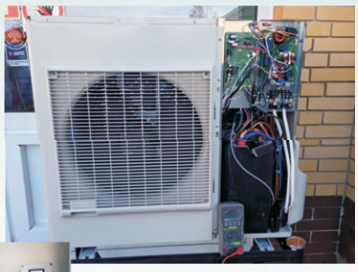
R&D project: Control of air-water heat pump

The heat pump absorbs heat from a cold space and transfers it to a warmer one





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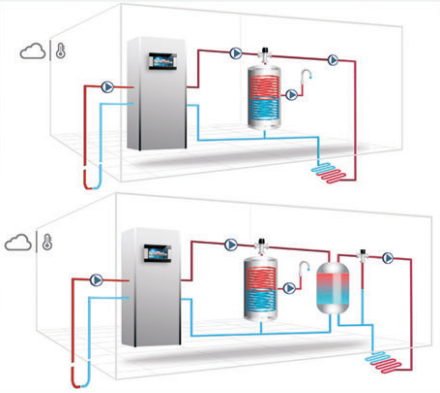
R&D project: Control of air-water heat pump

The controller:

- Maximises the Coefficient of Performance (COP)
- Minimises energy consumption
- Automatically adapts to changing environmental conditions



The controller is on the market (manufactured by ***Plum*** company)

Software Engineering Group

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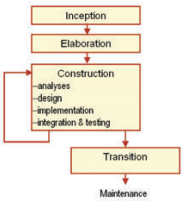
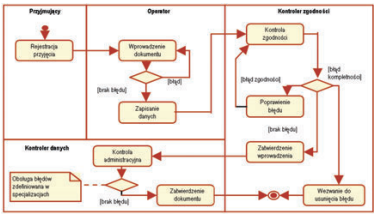
Software development

Research topics:

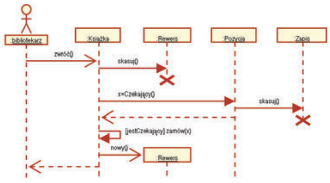
- Business process modeling
- Requirements engineering
- Software development methods
- Technologies and tools
- Acceptance testing
- Software processes
- Project management





Systems and tools **:**

- Rational Rose
- Rational RequisitePro
- Structured Architect



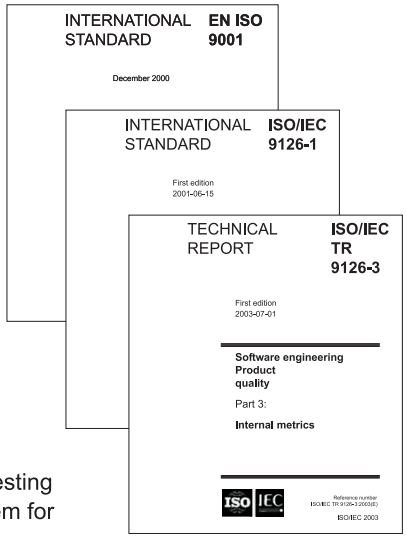
Software Engineering Group

Instytut Automatyki i Informatyki Stosowanej

Evaluation of the software quality

Research topics:

- Quality of the software process
- Quality of the software products
- Evaluation method:
  - Defining the set of quality criteria
  - Defining the set of questions
  - Evaluation and ranking
  - Threats and recommendations



Sample projects:

- Evaluation of the expected quality of software developed for IACS (support system for EU Common Agriculture Policy in Poland)
- Supervision and evaluation of the acceptance testing of the integrated management and control system for the post delivery service in Poland

Software Engineering Group

Instytut Automatyki i Informatyki Stosowanej

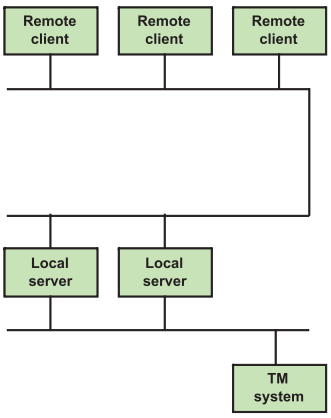
Distributed Open Systems

Research topics:

Ø Service Oriented Architectures (SOA)
- Architecture and Architecture Decisions
- System Development
- Evolution and Transformation

Ø Security in Distributed Open Systems

Ø Role-Based Trust Management languages
- Syntax and Semantics
- Credentials
- Credential Chain Discovery

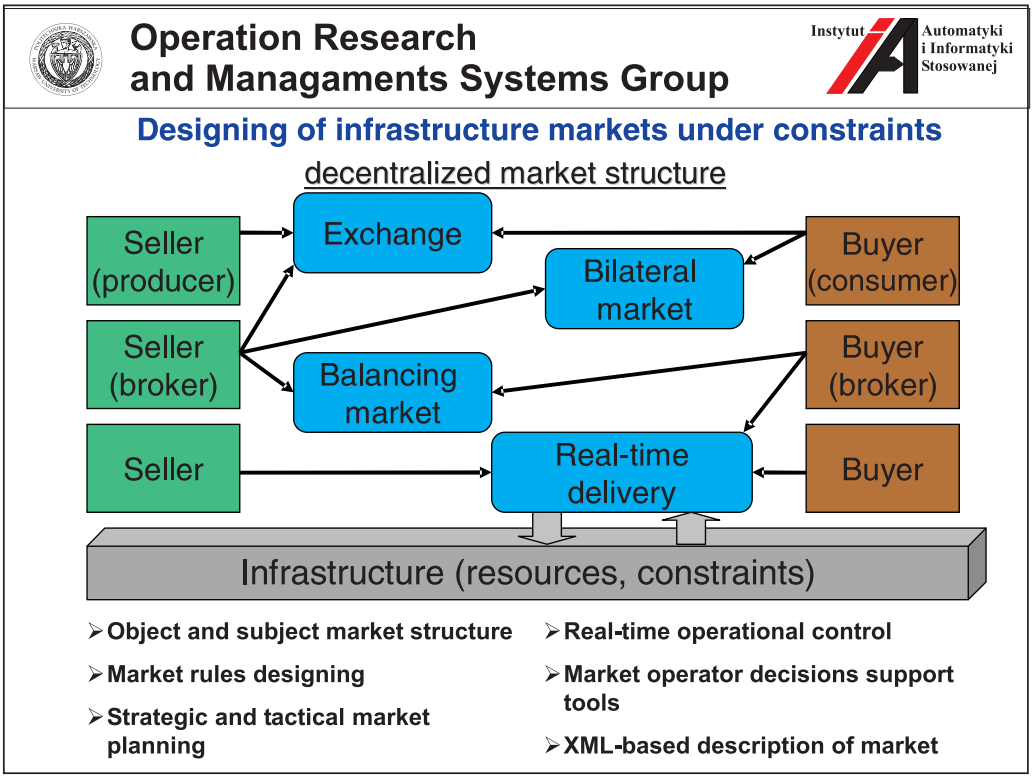


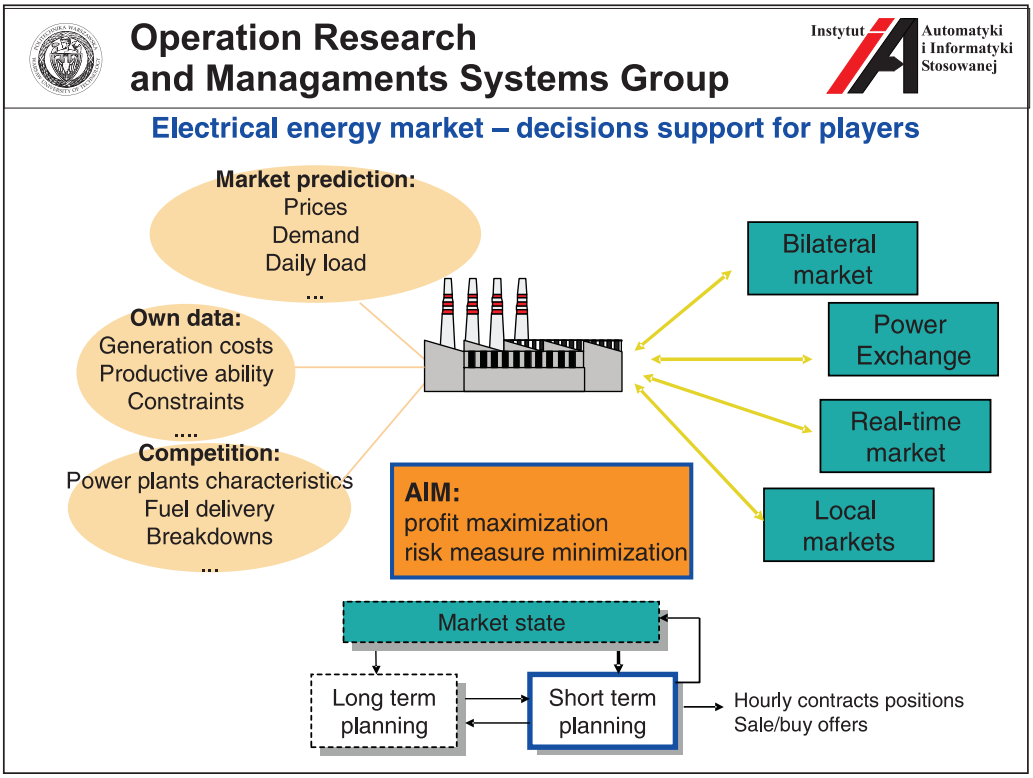
Languages and Conceptual Tools:

Ø BPMN, BPEL

Ø RT_0, RT_1, RT_2, RT^T

Ø Architecture Decision Models

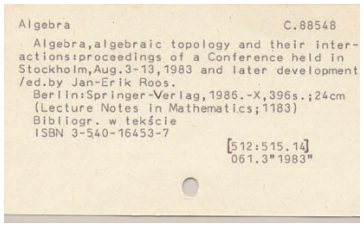

Operation Research
and Managaments Systems Group
Instytut Automatyki i Informatyki Stosowanej
Designing of infrastructure markets under constraints
decentralized market structure
Seller (producer)
Seller (broker)
Seller
Exchange
Bilateral market
Balancing market
Real-time delivery
Buyer (consumer)
Buyer (broker)
Buyer
Infrastructure (resources, constraints)
Object and subject market structure
Market rules designing
Strategic and tactical market planning
Real-time operational control
Market operator decisions support tools
XML-based description of market


Operation Research
and Managaments Systems Group
Instytut Automatyki i Informatyki Stosowanej
Electrical energy market – decisions support for players
Market prediction:
Prices
Demand
Daily load
...
Own data:
Generation costs
Productive ability
Constraints
....
Competition:
Power plants characteristics
Fuel delivery
Breakdowns
...
AIM:
profit maximization
risk measure minimization
Bilateral market
Power Exchange
Real-time market
Local markets
Market state
Long term planning
Short term planning
Hourly contracts positions
Sale/buy offers

Operation Research and Managaments Systems Group

Instytut Automatyki i Informatyki Stosowanej

Library catalogue digitization

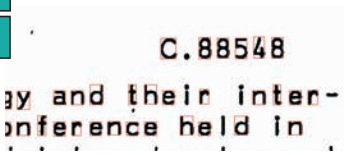


Skew correction

Binarization

Noise elimination

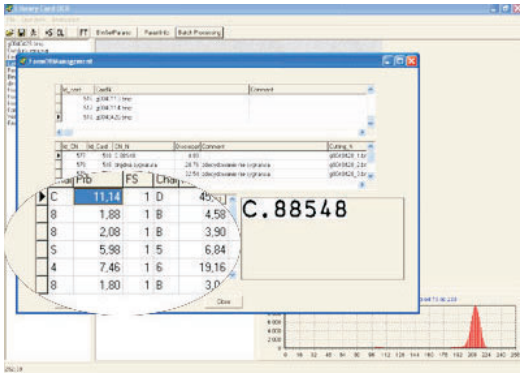
Segmentation



Framing

Recognition

C.88548



Operation Research and Managaments Systems Group

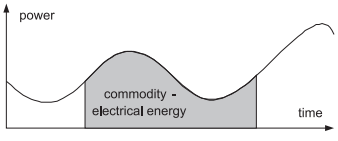
Instytut Automatyki i Informatyki Stosowanej

M³ Multicommodity Market Model

M³ is a flexible and universal market data and communication model
http://www.openm3.org

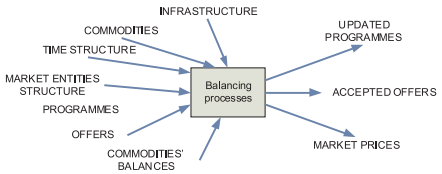
M³ is mainly (but not only) designed for

- **Centralized** (auctions, exchanges) and **distributed, multicommodity** markets
- **Infrastructure** markets
- „**Real-time**" markets on which commodities
  - are non-storable, localized in time and space,
  - delivered too late become worthless, their storage is limited
  - are integrals of some instantaneous values



M³ consists of several layers: formal mathematical model, conceptual data model, expressed in form of UML class diagrams, exemplary relational database structure, XML schemas for static data, communication models and XML schemas for messages and Web Services definitions.

Conceptual model of M³ describes the inputs and outputs of elementary balancing process:



M³ helps markets' development by providing

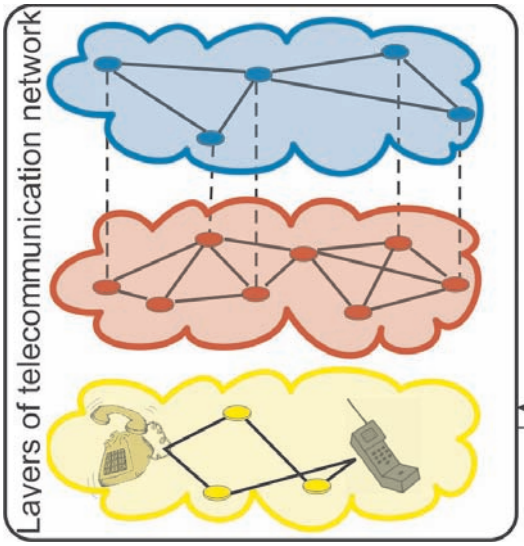
- flexible framework both for real-world market systems and for research projects
- possibilities for integration of software components
- possibilities for organizing benchmark data repository

Operation Research and Managaments Systems Group

Instytut Automatyki i Informatyki Stosowanej

Design of Multicommodity Market Model – M³

Application of M³ on the Communication Bandwidth Market



M³ model:

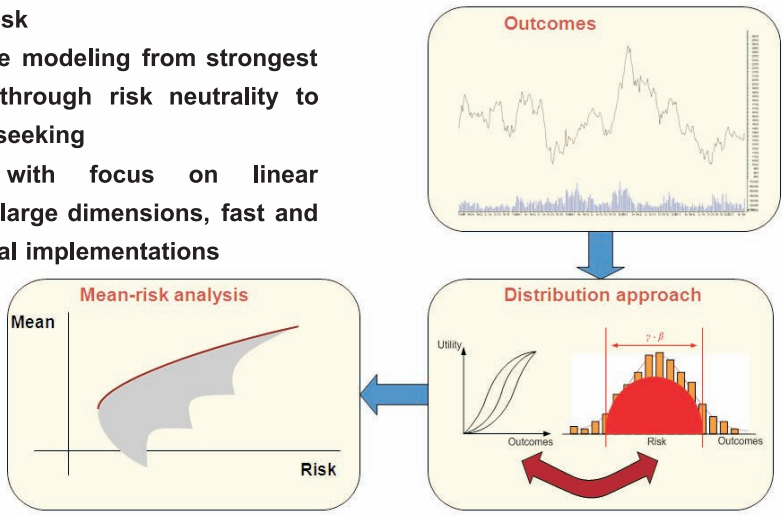
- may be used in information systems for market balancing in various infrastructure networks
- is a set of formal data models, which results in XML-derived information interchange specification
- may be used in a wide range of market-oriented network systems and may significantly facilitate communication, coordination and modelling procedures

Optimization and Decision Support Group

Instytut Automatyki i Informatyki Stosowanej

Risk Measures and Optimization under Risk

- Focus on risk measures consistent with axiomatic models of preferences for choice under risk
- Risk preference modeling from strongest risk aversion through risk neutrality to strongest risk seeking
- Optimization with focus on linear programming: large dimensions, fast and stable numerical implementations

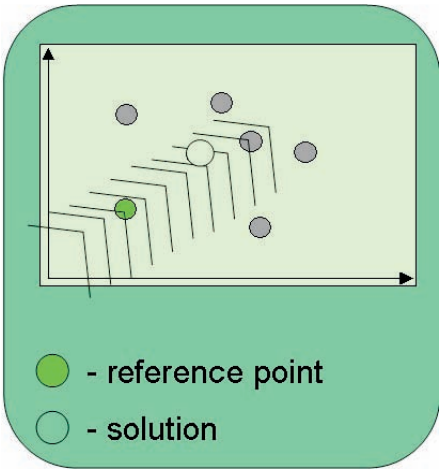


Optimization and Decision Support Group

Instytut Automatyki i Informatyki Stosowanej

Reference Point Method

- interactive method for multicriteria model analysis
- guiding information by specification of the reference points
- a Pareto-optimal solution is selected for a given reference point

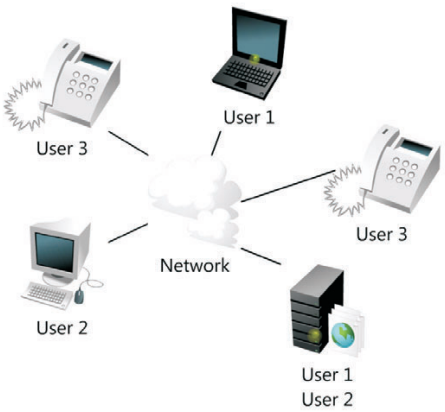


Optimization and Decision Support Group

Instytut Automatyki i Informatyki Stosowanej

Fair network design and optimization

- Optimization of networks (systems) which serve many users
- User = demand between a pair of nodes
- Shared resources (node/link capacities)
- Elastic demand – user can consume any bandwidth assigned
- The goal: resource assignment that is effective and fair (acceptable for all users)



1.4 Statistical Data

FACULTY and STAFF	2014 persons	2015 persons	2016 persons
Academic Staff	43	37(+3)	39(+3)
by titles/degrees			
Professors	8	8	9
D.Sc.-s	5	6	6
Ph.D.-s	28	21(+3)	18(+3)
M.Sc.-s	2	2	6
by positions			
Professors	9	10	10
Readers	1	1	1
Assistant Professors	31	24(+3)	21(+3)
Senior Lecturers	2	2	3
Assistants	0	0	2
Ph.D. Students	27	27	19
Technical Staff	6	9(+1)	5
Administrative Staff	9	7	7

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

ACTIVITIES	2014	2015	2016
Teaching activities			
standard teaching potential, hours	9 086,00	9 754,50	9 187,8
# hours taught	12 246,40	13 995,20	14 107,4
Degrees awarded			
Professor	1	0	0
D.Sc	0	1	2
Ph.D.	1	5	0
M.Sc.	46	48	36
B.Sc.	45	40	49
Research projects			
granted by WUT	5	5	5
granted by State institutions	12	11	6
granted by international institutions	1	1	1
other	8	8	8
Sci.-Tech. publications			
monographs (authored or edited)	7	5	3
chapters in books and proceedings	61	50	60
papers in journals	32	31	32
Reports, abstracts and other papers	33	21	16
Conferences			
participation (# of conferences)	22	34	14
participation (# of part. from ICCE)	43	54	39

RESOURCES	2014	2015	2016
Space (sq.m.)			
laboratories	585	995	644
library + seminar room	74	74	182
faculty offices	724	724	821
Computers			
personal computers	175	192	185
Library resources			
books	3 141	3 151	3 154
booklets	2 635	2 724	2 809
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, 2015.

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 and Pattern Recognition 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 Devision, Control Engineering Group
room CS402
p.chaber@ia.pw.edu.pl

M.Sc. 2014 from WUT.

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

Adam Czajka Assistant Professor (on leave)

Systems Control Division, Biometrics and Machine Learning Group
A.Czajka@ia.pw.edu.pl, www.ia.pw.edu.pl/~aczajka

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

Received his M.Sc. in Computer Control Systems in 2000 and Ph.D. in Biometrics in 2005 from Warsaw University of Technology (both with the highest honours). Since 2003 he is with Warsaw University of Technology, and since 2002 with Research and Academic Computer Network (NASK). Visiting Associate Professor at the Department of Computer Science and Engineering of the University of Notre Dame, IN, USA (fall 2014 and since spring 2016). Chair of the Biometrics and Machine Learning Laboratory at the Institute of Control and Computation Engineering. Head of the Postgraduate Studies on Security and Biometrics (2011-). V-ce Chair of the NASK Biometrics Laboratory (2006-) and a member of the NASK Research Council (2006–2015). Member (2009-) and Chair (2014-) of the Technical Committee on Biometrics of Polish Normalization Committee (PKN). Member of the PKN Technical Committee No. 182 on Information Security in IT Systems (2007-2016). Expert of the ISO/IEC SC37 and CEN TC224 WG18 on Biometrics. Associate Editor for IET Biometrics and IEEE Access. Member of the Main Council of the Research Institutes (2015-2016). Associate Member (2002–2005), Member (2006–2011) and Senior Member (2012-) of the IEEE (Institute of Electrical and Electronics Engineers, Inc.). Active Member of the EAB (European Association for Biometrics, 2012-).

Interests: Biometrics, computer vision, machine learning.

Paweł Domański Assistant Professor
Control and Software Engineering Division, Control Engineering Group
room 570, **tel. 22 234 7665**
P.Domanski@ia.pw.edu.pl

M.Sc. 1991, Ph.D. 1996 from WUT.

With WUT since 1991.

Interests: Adaptive control, intelligent control, fuzzy logic.

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 Assistant Professor
Operations and Systems Research Division,
Operations Research and Management Systems Group
room 561, **tel. 22 234 7123**
M.Kaleta@ia.pw.edu.pl

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

With WUT since 2003.

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

Mariusz Kamola Assistant Professor (part-time)

Systems Control Division, Complex Systems Group

room 573, tel. 22 234 7126

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

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

With WUT since 2002.

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

Andrzej Karbowski Assistant Professor

Systems Control Division, Complex Systems Group

room 572, tel. 22 234 7632

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

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

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

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

Michał Karpowicz Assistant Professor (part time)

Systems Control Division, Complex Systems Group

room 573a, tel. 22 234 7860

M.karpowicz@ia.pw.edu.pl, staff.elka.pw.edu.pl/~mkarpowi

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

With WUT since 2014

Interests: Control theory, game theory, computer networks

Włodzimierz Kasprzak Professor

Systems Control Division, Robot Programming and Pattern Recognition Group

room 565, tel. 22 234 7866

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

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

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

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

Tomasz Kornuta Assistant Professor (on leave)
Systems Control Division, Robot Programming and Pattern Recognition Group
T.Kornuta@elka.pw.edu.pl, http://tkornuta.googlepages.com

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

With WUT since 2008.

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

Adam Kozakiewicz Assistant Professor (part time)
Systems Control Division, Complex Systems Group
room 573a, tel. 22 234 7860
akozakie@elka.pw.edu.pl

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

With WUT since 2006.

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

Bartosz Kozłowski Assistant Professor (on leave)
Operations and Systems Research Division, Optimization and Decision Support Group
B.Kozlowski@elka.pw.edu.pl

M.Sc. 2004 from WUT.

With WUT since 2010.

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

Tomasz Jordan Kruk Assistant Professor
Systems Control Division, Complex Systems Group
room 530, tel. 22 234 7922
T.Kruk@ia.pw.edu.pl, www.ia.pw.edu.pl/~tkruk

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

With WUT since 1999.

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

Adam Krzemienowski Assistant Professor
Operations and Systems Research Division, Optimization and Decision Support Group
room 553, tel. 22 234 7640
A.Krzemienowski@ia.pw.edu.pl

Ph.D. 2007 from WUT.

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

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

Maciej Ławryńczuk Professor (Leader of the Group)

Control and Software Engineering Division, Control Engineering Group

room 563, tel. 22 234 7124

M.Lawrynczuk@ia.pw.edu.pl

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.

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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.

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M.Sc. 1986, Ph.D. 1995, D.Sc. 2005 from WUT.

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.

Interests: Large scale systems, computer simulation, computer aided control systems design, environmental systems management, distributed computations, global optimization, telecommunication systems, ad hoc networks. Member of of the Scientific Council of NASK since 2002 (Vice-Chairman 2008–2009). Ekspert of the Polish Accreditation Committee, Member of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN).

Włodzimierz Ogryczak Professor (Director of the Institute, Leader of the Group)
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M.Sc. 1973, Ph.D. 1983 in Mathematics from Warsaw University, D.Sc. 1997 in Computer Science from PAN, the title of Professor of Technical Sciences awarded in 2011.

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

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

Andrzej Pacut Professor (Leader of the Group)

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

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

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

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

With WUT since 2009. Member of the Rectorñs 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.

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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.

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Control and Software Engineering Division

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

With WUT since 2015.

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

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

With WUT since 2009.

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

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.

Jerzy Sobczyk Senior Lecturer (part-time)

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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, Äbo Swedish Academy in Turku, 1987, Jyväskylä University, Finland, 1988, JSPS invitee at the Department of Control Engineering, Osaka University, Japan, 1988–89. Member of Polish Society of Operations and Systems Research. Author and co-author of many scientific papers and reports on optimization algorithms, identification, applications of optimizations in macro-economy modeling and optimal design problems in structural engineering. Co-author of a textbook 'Podstawy optymalizacji' ('Foundations of Optimization') published in 1999. Reviewer of Control & Cybernetics, Optimization, Archives of Control Science, SIAM J. on Optimization, IEEE Concurrency.

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

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

With WUT since 2005.

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

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

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

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

Tomasz Śliwiński Assistant Professor

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

With WUT since 2004.

Interests: Discrete optimisation, operations research, decision support.

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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, since 2007 Chair of the Automatic Control Systems Section of this Committee, 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–).

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_2 Reduction Emission Program, and Head of the Energy Market Group (2009–), Member of the European Commission DG Advisory Group for Energy Roadmap 2050 (2011–).

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

Tomasz Traczyk Reader (Deputy Director of the Institute)

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

With WUT since 1984.

Interests: Applications of DBMS in management and control, information systems, Web-based systems, XML language and its applications, variant configuration, long-term digital archives.

Paweł Wawrzyński Assistant Professor

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M.Sc. 2001, Ph.D. 2005 from WUT., D.Sc. 2016 from WUT.

With WUT since 2005.

Interests: Reinforcement learning, neural networks; learning robots, adaptive control, computational neuroscience.

Tomasz Winiarski Assistant Professor

Systems Control Division, Robot Programming and Pattern Recognition Group

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twiniarski@gmail.com, http://robotyka.ia.pw.edu.pl/team/twiniarski

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 Zalewski Assistant Professor (Leader of the Group)

Control and Software Engineering Division, Software Engineering Group

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

A.Zalewski@ia.pw.edu.pl

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

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

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

Cezary Zieliński Professor (Leader of the Group)

Control and Software Engineering Division,
Robot Programming and Pattern Recognition 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–). Vice Dean for Research and International Cooperation FEIT (2002–2005), Head of ICCE Robot Programming and Pattern Recognition Group since 1996. 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–).

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

Izabela Żółtowska Assistant Professor

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

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I.Zoltowska@elka.pw.edu.pl, home.elka.pw.edu.pl/~imilenko

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

With WUT since 2005.

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

2.3 Supporting Faculty and Staff

Wojciech Dudek Software Engineer (part time)
Systems Control Division, Robot Programming and Pattern Recognition Group
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M.Sc from WUT.

With WUT since 2013.

Włodzimierz Macewicz Senior Software Engineer
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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 Oct. 2016)
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M.Sc from WUT.

With WUT since 2015.

Mateusz Trokielewicz Software Engineer (part-time, since August 2016)
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2.4 Ph.D. Students

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2.5 Administrative and Technical Staff

Elżbieta Matyjasiak Secretary, Main office.

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

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baccalaureate 2005 from Leon Kozmiński Academy of Entrepreneurship and Management

Alicja Trojanowska Secretary, Student affairs.

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baccalaureate 2012 from WUT.

Beata Woźniak Manager, Administration.

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B.Wozniak@ia.pw.edu.pl

M.Sc. 1993 from Warsaw University.

3 Teaching Activities – Academic Year 2015/2016

3.1 Undergraduate and Graduate Studies

Course Title	Course code	Hours per week	Class	Lecturer
Adaptive and Learning Systems	SAU	2 – 1 –	PP-SID SIDJ	P.Wawrzyński (spring/fall)
Administration of UNIX and TCP/IP	ASU	2 – 1 –	OSK,OT, MERJ	J.Sobczyk (fall)
Advanced Process Control Techniques	TAP	2 – – 2	PZ-AIR, PZ-A, PZ, OT	P.Tatjewski (spring)
Algorithms and Data Structures	AISDI	2 – 1 –	sem.3	A.Zalewski (spring)
Optimization Algorithms and Methods	AMO	2 – -2	OT, PZ, PZ-A, PZ-AIR, PZ-OTJ	A.Stachurski (spring)
Anatomy of Robots	ANRO	1 – 2 –	OT, PODAA	C.Zieliński (spring)
Systems Architecture and Integtation	AIS	2 – 1 –	PZ-OWJ, PZ-OTI	A.Ratkowski (spring/fall)
Artificial Intelligence	EAI	2 – – –	ANGL, OT	W.Kasprzak (spring).
Automation and Robotics Equipment	APA	2 – 1 –	PODAA, OT	T.Winiarski (spring/fall)
Basics In Automatics	PODA	2 – 1 –	PSTER, OT, PSYIA	P.Tatjewski (spring) K.Malinowski (fall)
Biometric Identity Verification	BIT	2 – 1 –	OT, SIDJ,PP-SID	A.Pacut (spring/ fall)
Commercial Data Bases 2	KBD2	2 – – 2	BDSI, OT	T.Traczyk (fall)
Computer Networks	ECONE	2 1 1 –	ANGL, OT	J.Sobczyk (spring)
Computer Networks (I)	SKM	2 – 1 1	SKOR, OT	J.Sobczyk (spring/fall)
Computer Vision	ECOVI	2 1 – –	Emaro	W.Kasprzak (fall)
Data Bases 2	BD2	2 – – 1	BDSI, OT, SIDJ, PP-SID	T.Traczyk (spring/fall)
Decision Support	WDEC	2 – 2 –	MKPWD, OT, PP-SID	J.Granat (spring/fall)
Decision Support Under Risk Conditions	WDWR	2 – – 1	PZ-I, OT, MKPWD,PZ, PZ-OWJ, PP-SID	A.Krzemienowski (spring)
Distributed Operating Systems	RSO	2 – 1 –	PZ, OT, PZ-I, PZ-SID, PZ-ISI	T.Kruk (spring)
Dynamic systems and control	EDYCO	2 1 1 –	ANGL, CIRCAB, ECETC, OT	P.Domański (spring/fall)
Event programming (I)	PROZ	2 – – 1	ATP, OT	M.Kamola (fall)
Fundamentals of Artificial Intelligence	PSZT	2 – – 1	ISO, OT, PINJ, PP-SID	P.Wawrzyński (spring/fall)
Fundamentals of Digital Technology	PTCY	2 – 2 –	sem. 2	C.Zieliński (fall)
Fundementals of Operation Research	POBO	2 – 1 –	Sem. 4	K.Pieńkosz (spring) E.Toczyłowski (fall)
Fundamentals of Optimization	POPTY	2 – 2 –	MKPWD, OT, PP-SID	A.Stachurski (fall)
Fundamentals of Parallel Computation	PORR	2 – – 2	SKOR, PZ-A, PZ-I	E.Niewiadomska--Szynkiewicz (fall)
Fundamentals of Programming	PRI	2 1 2 –	Sem.1	T. Śliwiński(spring)
Group Project	EGPRR		EMARO	C.Zieliński (spring)
Image and Speech Recognition	EIASR	2 1 – 1	ANGL.OT	W.Kasprzak (fall)
Information Project Management	ZPI	2 – – 1	BDSI, OT, METJ	K.Pieńkosz (spring/fall)
Inteligentne systemy robotyczne	ISR	2 – 1 –	PZ-AIR, PZ-OWJ, PZ-SID, PZ-A, OT	C.Zieliński (fall)
Introduction to Robotics	WR	2 – 2 –	MUS, SCRJ, OT	W.Szynkiewicz (spring/fall)
Numerical Methods (J)	MNUM	2 – – 1	PSTER, OT, PP-SID, SIDJ, MATA, MKPWD	P.Tatjewski (spring/fall)

Course Title	Course code	Hours per week	Class	Lecturer
Numerical Methods	ENUME	2 – 2 –	ANGL, OT	P.Marusak (fall)
Management IT Systems	SIZ	2 – – 2	MKPWD, OT, SWDJ	J.Granat (spring)
Methods for Identification	MI	2 – – 1	OT, PZ, PZ-A, PZ-AIR	P.Domański (fall)
Mobile Robots	EMOR		ANGL, ECETC, OT	W.Szynkiewicz (spring)
Modeling and Control of Manipulators	EMOMA	3 1 – –	Emaro	C.Zieliński (fall)
Modelling and Identyfication	MODI	2 1 – 1	PODAA, PZ-AIR, OT	P.Domański (fall/spring)
Modeling and Control of Robots	MORO	2 – – 1	OT, PZ, PZ-A, PZ-AIR	C.Zieliński (fall)
Modeling and Computer Simulation	MISK	2 – –2	OT, PZ, PZ-A, PZ-OTA	E.Niewiadomska--Szynkiewicz (spring)
Networks Systems Control	SST	2 – – 1	PZ-AIR, PZ-A, PZ, OT	K.Malinowski (spring)
Object Programming	PROI	2 – 2 –	MPRIA, OT	T. Śliwiński (fall)
Operating System	EOPSY	2 1 1 –	ANGL, OT	T.Kruk (spring)
Optimization Techniques	EOPT		Emaro	W.Ogryczak (spring)
Operating Systems	SOI	2 – 2 –	OSK, OT	T.Kruk (fall)
Optimization and Decision Support	OWD	2 – – 1	PZ-A, PZ-I, OT	W.Ogryczak (fall)
Parallel Numerical Methods	EPNM	2 – –2	ANGL, CSNAD, ECEEL, OT	A.Stachurski (spring)
Process Control	STP	2 1 1 –	OT, PSTER	M. Ławryńczuk (fall) P.Marusak (spring)
Process Management and Scheduling	ZAH	2 – 2 –	MKPWD, OT, MUS, PP-SID, SWDJ	E.Toczyłowski (spring/fall)
Programming Fundamentals	EPFU	2 1 1 –	ANGL, OT	M.Kaleta (spring/fall)
Programmable Controllers	SP	2 – 1 –	MUS, OT, METJ	J.Gustowski (spring/fall)
Real-time Systems	ERTS	2 – 2 1	EMARO	T.Kruk (fall)
Real-time Systems	SCZR	2 – 2 –	PSTER, OT, PINJ, PP-SID	K.Sacha (spring/fall)
Robot Programming Methods	EPRM		EMARO	C.Zieliński (spring)
Signal Processing	ESPRO	2 1 – –	EMARO	W.Kasprzak (fall)
Software Engineering	IOP	2 – 1 –	OSK, OT, PINJ, PP-SID	K.Sacha (spring/fall)
Software Specyfication and Design	SPOP	2 – 1 –	OSK, PZ-SID, PZ-I, OT	M.Szlenk (spring/fall
Soft Computing in Process Control	SZAU	2 – – 2	OT, PZ, PZ-A, PZ-AIR	M.Ławryńczuk (fall) P.Marusak
Control Theory	TST	2 1 – 1	OT, PZ, PZ-A, PZ-AIR	M.Karpowicz (fall)
Techniques for Social Network Analysis	TASS	2 – –2	OT, PZ, PZ-OWJ	P.Arabas (fall)
Multi-agent decision support systems	WSD	2 – – 2	OT, PZ, PZ-OWJ	P.Pałka (fall)

Table explanations

Hours per week

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

Class

Symbol	Level	Description
ANGL	all levels	taught in English
ATP	B.Sc.	specialization in Programming Algorithms
BDSI	B.Sc.	specialization in Databases and Information Systems
ISO	B.Sc.	specialization in Intelligent Computation Systems
MKPWD	B.Sc.	specialization in Computer Methods of Decision Support
MUS	B.Sc.	specialization in Control Systems and Methods
OSK	B.Sc.	specialization in Computer System Programming
OT, ECETC	all levels	free electives
PSTER	B.Sc.	specialization in Control
PSYIA	B.Sc.	specialization in Computer, Networks and Systems
PP-SID	M.Sc., Ph.D.	fundamental classes, Decision and Information Systems
PZ-A	M. Sc., Ph.D.	advanced classes, control
PZ-I	M. Sc., Ph.D.	advanced classes, informatics
PZ-P	M. Sc., Ph.D.	advanced classes, fundamental
PZ-SID	M.Sc., Ph.D.	advanced classes, Decision and Information Systems
SCRJC	B.Sc., M.Sc.	specialization in Control Systems
SKOR	B.Sc.	specialization in Computer Networks and Distributed Computations
SYK	B.Sc.	specialization in Computer Systems

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] **Automatic Classification of Iris Image Orientation (ACII)**

Granting period: January – August 2016. Role: researcher

Partner: FBI Biometric Center of Excellence (via West Virginia University, USA)

Coordinator: Adam Czajka

[PR2] 7 FP EU grant No. FP7–ICT–2013–10, FP7–ICT–2013.5.3: **RAPP – Robotic Applications Store for Delivering Smart User Empowering Applications.**

Granting period: 01.12.2013–30.11.2016.

Coordinator: Centre for Research and Technology Hellas/Informatics and Telematics Institute (Greece).

Partners: Institute National de Recherche en Informatique et Automatique (France), Warsaw University of Technology (Poland), Sigma-Orionis (France), Ormylia Foundation (Greece), Ingema Foundation (Spain), Ortelio Ltd. (UK), Aristotel University (Greece).

Project coordinator from WUT: Cezary Zieliński.

Investigators from WUT: Wojciech Szynkiewicz, Włodzimierz Kasprzak, Tomasz Michał Kornuta, Tomasz Winiarski, Michał Walęcki, Maciej Stefańczyk, Jan Figat, Maksym Figat, Marcin Szlenk, Konrad Banachowicz, Teresa Zielińska.

Aim of the project: RAPP (Robotic Applications for Delivering Smart User Empowering Applications) produced a software platform to supporting the creation and delivery of robotics applications (RAPPs) targeted at people at risk of exclusion, especially elderly people. The open-source software platform provides an API that contains the functionalities for implementing RAPPs and accessing the robot's sensors and actuators using higher level commands, by adding a middleware with added functionalities suitable for different kinds of robots. RAPP expands the computational and storage capabilities of robots and enables machine learning operations, distributed data collection and processing, and knowledge sharing among robots in order to provide personalized applications based on adaptation to individuals. The use of a common API assists developers is creating improved applications for different types of robots that target people with different needs, capabilities and expectations, while at the same time respect their privacy and autonomy, thus the proposed RAPP Store will have a profound effect in the robotic application market. The results of RAPP were evaluated through the development and benchmarking of social assistive RAPPs, which exploit the innovative features (RAPP API, RAPP Store, knowledge reuse, etc.) introduced by the proposed paradigm.

Results: Creation of an infrastructure for developers of robotic applications, so they can easily build and include machine learning and personalization techniques to their applications. Creation of a repository, from which robots can download Robotic Applications (RApps) and upload useful monitoring information. Development of a methodology for knowledge representation and reasoning in robotics and automation, which allows unambiguous knowledge transfer and reuse among groups of humans, robots, and other artificial systems. Creation of RApps based on adaptation to individuals, taking into account the special needs of elderly people, while respecting their autonomy and privacy. Validation of this approach by deploying appropriate demos to demonstrate the use of robots for health and motion monitoring, and for assisting technologically illiterate people or people with mild memory loss.

Keywords: elderly, social robots, assistive robots, robotic framework, smart user empowering robotic applications, mobility assistance and health monitoring, technology illiterate

[PR3] NCN Grant OPUS 9 no: UMO-2015/17/B/ST6/01885 **Energy-aware computer system for HPC computing**

Granting period: 18.02.2016–17.02.2019

Principial investigators: Ewa Niewiadomska-Szynkiewicz, Michał Karpowicz IAiIS 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.

[PR4] NCBiR Grant DEMONSTRATOR+ No. WND–DEM–1–385/00: **Digital Document Repository CREDO.**

Granting period: 01.11.2013–31.05.2016.

Coordinator: Polska Wytwórnia Papierów Wartościowych. S.A, Partners: Warsaw University of Technology, Skytechnology sp. z o.o.

Principal investigator from WUT: Tomasz Traczyk.

Investigators from WUT: Włodzimierz Ogryczak, Grzegorz Płoszajski, Bartosz Kozłowski, Piotr Pałka, J. Hurkała, A. Hurkała.

Aim of the project: The goal of the CREDO project is to design and launch a demonstrative version of a digital repository enabling short- and long-term archiving of large volumes of digital resources. By design the repository is to act both as a secure file storage and as a digital archive providing metadata management and including the resources in archival packages.

Expected results: One of the system's primary functions will be the support for various currently available data carriers: hard drives, solid state drives, tapes. The repository will ensure a high level of security for the information stored through, among other things, advanced access rights management methods and the capability to encrypt the resources stored. Reliability of information readouts will be ensured by the data recording replication mechanisms in the repository's file system, as well as the distributed nature of the system that will enable storing copies of the resources in more than one locations. The repository's architecture will be multi-tiered and it will enable (together with the emergence of new technologies) replacement and continuous upgrades of the individual components. This solution has been designed for

institutions that store large digital resources for long periods of time, e.g. cultural institutions, mass media, state administration offices, and health care institutions. The system designed is to have the features of a product ready to be offered to users.

Keywords: digital resources, long-term archiving, long-term storage, metadata.

[PR5] NCN OPUS Grant No. 2012/07/B/HS4/03076: **Construction of robust investment portfolios by means of the generalized ordered weighted averages.**

Granting period: 01.07.2013–30.06.2016.

Principal investigator: Włodzimierz Ogryczak.

Investigators: Adam Krzemienowski, Tomasz Śliwiński, Michał Przyłuski, Jarosław Hurkała.

Aim of the project: The basis of the portfolio selection is to determine the share of each financial asset. From a mathematical point of view, this issue boils down to portfolio optimization. This is a typical optimization problem solved by the Markowitz method, which maximizes the expected rate of return and minimizes risk defined as the variance. The assumptions of the Markowitz model should ensure that the optimal portfolios are stable over time, i.e., they should be characterized by the absence of fluctuations in their shares, or in other words, the risk and the expected return should correspond to those estimated from the historical data. In practice, these assumptions are not met. The aim of the project is to develop and analyze a new method that selects robust portfolios, stable over time in terms of their composition for the assumed set of financial assets. The method is supposed to bring out-of-sample results no worse than in-sample results for some performance measures for a given tolerance level.

Expected results: Development and analysis of a portfolio optimization procedure suited for risk measures consistent with the axiomatic models for choice under risk. One of the scientific objectives of the project is to develop and analyze risk measures based on the generalized ordered weighted average operators with reach preference modeling capabilities. There is also planned to develop and empirically analyze efficient algorithms for portfolio optimization models incorporating developed risk measures. In particular, the performance of the risk measure called Multivariate Conditional Value--at-Risk (MCVaR) applied to a portfolio optimization problem with the multivariate robust distribution.

Keywords: portfolio optimization, portfolio mangement, financial engineering, operations research, robustness, risk, decision support.

[PR6] NCN SONATA Grant No. 2012/05/D/ST6/03097: **Methodology of design and implementation of multi-sensory robotic systems for service purposes.**

Granting period: 01.02.2013–3.10.2016.

Principal investigator: Tomasz Winiarski.

Investigators: Wojciech Dudek, Maksymilian Figat, Tomasz Kornuta, Michał Walęcki, Maciej Stefańczyk, Bartosz Świstak, Łukasz Żmuda, Konrad Banachowicz, Dawid Seredyński, Karol Kateržawa, Michał Laszkowski, Anna Wujek.

Aim of the project: The aim of the research is to develop a method of design and implementation of intelligent service robots. It has been established that in order to execute the tasks formerly exclusively performed by humans, such a system requires sensors corresponding to human senses such as sight and perception of force as well as appropriate processing algorithms. In this project we focus on developing the algorithms and the technology necessary for creating a working robotic system, able to

locate and classify objects, generate an appropriate plan of approaching those objects and, in the final phase, their classification and manipulation using appropriate tool assuming that the object have internal degrees of freedom.

Expected results: The societies of developed countries have been prospering for many years, but at the same time they have to face the problem of aging. In consequence, there is a great demand for services for people (especially elders), but those services are invariably time-consuming, and involving other people. It's arguable whether acquiring cheap workforce is a solution to that problem. An alternative solution is automating the work formerly done by economic emigrants. This challenge has been taken by roboticists who developed service robotics. Their work resulted in creating vacuuming or lawn-mowing robots. However, commercially built robots do not have manipulation skills which are essential to performing useful tasks in human environment. The proposed research project focuses on manipulation and developing technologies for aiding manipulation (such as multi-sensory perception). This remains in agreement with current trends in service robotics while at the same time attempting to evolve it in a direction that is arguably crucial.

Keywords: robotics, manipulation, control systems.

[PR7] Statutory Grant No. 504G036300: **Development of methodology of control, decision support and production management**.

Granting period: 19.05.2015–31.12.2016 and 4.05.2016–31.12.2017

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

[PR8] 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: 20.12.2015–30.09.2017.

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.

[PR9] Dean's Grant No. 504/02061/1031. **Coordination of reinforcement learning algorithms in cooperative, multi-agent systems**

Granting period: 06.05.2015–30.06.2016.

Principal investigator: Pałka Piotr.

Aim of the project: The aim of the project is to analyse algorithms for coordination in multi-agent systems using reinforcement learning methods. The precise formulation of generic reinforcement learning algorithm, that is used for coordination of Individual Learners (IL) by the Coalition Learner (CL) is done. On the base of literature review, five methods for Q function (and other parameters) modification was proposed: Distributed Q-learning, Dynamic Q-learning, Hysteretic and lenient learners, Win-or-learn fast policy hill climbing and Recursive frequency maximum Q-value. The methods are used in generic reinforcement learning algorithm for Q function of Individual Learner and Coalition Learner modification. The set of games for testing the algorithms is completed. The games are: Deterministic / Stochastic Game, Deterministic / Partially Stochastic / Fully Stochastic Climbing Game. Those games characterizes with different problems of individual learners coordination i.e.: Pareto-selection, non-stationarity, stochasticity, alter-exploration and shadowed equilibrium. Moreover, the simple auction game (double auction game) and complex auction game (optimal power flow auction game) are proposed. We developed the application for simulation of Individual Learners behaviour in the different cases, games and Q function of the Individual and Coalition Learner modification methods situation. The experiments for different games, and methods are developed.

Expected results: implementation of cooperative games (state-of-the-art, auction), analysis of the reinforcement learning algorithms for coordination in multi-agent systems for state-of-the-art games, analysis of the reinforcement learning algorithms for coordination in multi-agent systems for simple auction games, analysis of the reinforcement learning algorithms for coordination in multi-agent systems for complex auction games.

Keywords: multi-agent systems, agents coordination, agents cooperation, reinforcement learning.

[PR10] Dean's Grant No 504/02652/1031 **Development of methods for refining keypoint descriptors in object recognition task**

Granting period 19.05.2016–31.12.2016

Principal Investigator: Maciej Stefańczyk

Aim of the project: The aim of the project is to develop set of algorithms for incorporation of depth information during the process of keypoint descriptor extraction in image. The main goal is to use surface direction and curvature information, in order to minimize perspective distortions influence on the process. Another goal is to use point distance to select proper scale instead of calculating whole set of pyramid images. As a result, detected keypoints ad their descriptors should be more robust.

Expected results: As a result of the project, a set of algorithms for incorporating depth information in feature point descriptor extraction process will be developed. To make them robust and universal, proposed algorithm will have following properties:

– independence of acquisition device – any source capable of providing RGB-D data will be supported,

– independence of keypoint detector algorithm – precalculated point positions are given as an input for algorithm,

– independence of descriptor extractors – image after rectification will be passed as an input for extractors.

Additionally, to make development process faster and to be able to conduct comparative studies, simulator will be prepared. It will generate 3D views with different distortions.

Keywords: RGB-D, feature points, object recognition

[PR11] Research agreement No. 501210101424 with Emerson Process Management sp. z o.o **Development of laboratory exercises on single-input single-output and multiple-input multiple-output process control, development of software for laboratory exercises, development of 2 laboratory stands.**

Granting period: 01.11.2016–15.02.2017

Principal investigator: Maciej Ławryńczuk.

[PR12] Research agreement No. 501210101396 with Emerson Process Management sp. z o.o **Development of laboratory exercises on single-input single-output and multiple-input multiple-output process control, development of software for laboratory exercises, development of 3 laboratory stands.**

Granting period: 01.10.2016–31.12.2016

Principal investigator: Maciej Ławryńczuk.

[PR13] Research agreement No. 501230102531 with SAS Logistics Sp. z o.o. **Expert opinion on the completeness of the functionality of a software system.**

Granting period:01.08.2016–22.12.2016

Principal investigator: Andrzej Zalewski.

[PR14] Research agreement No. 501230102529 with CaSolutions Sp. z o.o. **Expert opinion on the completeness of the functionality of a software system.**

Granting period:27.07.2016–19.08.2016

Principal investigator: Andrzej Zalewski.

[PR15] Research agreements with Sąd Okręgowy w W-wie I Wydział Cywilny: **Expert opinions on the information systems and servises.**

Principal investigator: Andrzej Zalewski.

5 Degrees Awarded

5.1 D.Sc. Degrees

Dr Wojciech Szynkiewicz

Degree awarded on 23-02-2016

Dr Paweł Wawrzyński

Degree awarded on 13-12-2016

5.2 M.Sc. Degrees

Advisor: **Piotr Arabas**

P.Bartoszuk
Wykorzystanie profili czasowych do grupowania użytkowników sieci telefonicznej
Degree awarded on October 2016

Advisor: **Ilona Bluemke (II)**

M.Kurek
Testowanie serwisów webowych
Degree awarded on March 2016

Advisor: **Paweł Domański**

Ł.Stachurski
System do oceny jakości regulacji na podstawie metod fraktalnych
Degree awarded on June2016

P.Rękawek
Przygotowanie i walidacja nieliniowego modelu wymywania CO i CO2 do celu symulacji instalacji produkcji amoniaku
Degree awarded on July 2016 (with honors)

P.Weremiuk
Przygotowanie i walidacja nieliniowego modelu reaktora syntezy NH3 do celu symulacji instalacji produkcji amoniaku
Degree awarded on Novemer 2016

R.Kosk
Szczegółowy model walczaka wraz z mechanizmem automatycznej adaptacji
Degree awarded on October 2016

Advisor: **Janusz Granat**

M.Tomczuk
Wspomaganie decyzji z wykorzystaniem modeli matematycznych rynku usług szerokopasmowych
Degree awarded on March 2016

E.Wojdak
Prognozowanie we wspomaganiu zarządzania cenami w warunkach niepewności w systemach rezerwacyjnych
Degree awarded on October 2016

D.Waśniowski
Analiza strumieniowa w Internecie Rzeczy
Degree awarded on October 2016

Advisor: **Jerzy Gustowski**

A.Sowińska
Opracowanie stanowiska badawczego dla laboratorium systemów wizyjnych firmy Festo
Degree awarded on July 2016

J.Maciejczyk
Wykorzystanie wizji maszynowej w mechanizmie segregującym śruby
Degree awarded on October 2016

K.Kuryłek
Stanowisko laboratoryjne do badania zintegrowanych modułów napędowych firmy Festo
Degree awarded on October 2016

Advisor: **Stanisław Jankowski (II)**

T.Grel
Wykrywanie nadmiernego dopasowania w autoasocjacyjnych sieciach neuronowych przy użyciu metody wirtualnej skrajnej oceny krzyżowej
Degree awarded on March 2016 (with honors)

Advisor: **Mariusz Kaleta**

A.Wasik
Projekt i implementacja biblioteki programistycznej do mechanizmów aukcyjnych
Degree awarded on March 2016

Advisor: **Mariusz Kamola**

J.Jarzyński
Analiza triad w serwisach społecznościowych
Degree awarded on March 2016

P.Czeczko
Konstrukacja i weryfikacja wskaźnika atrakcyjności inwestycji mieszkaniowych
Degree awarded on October 2016

Advisor: **Włodzimierz Kasprzak**

A.Andrzejczak
Wyszukiwanie słów kluczowych w zapisie audio z wykorzystaniem algorytmu DTW
Degree awarded on March 2016 (with honors)

A.Szymanek
Program do wspomagania nauki śpiewu
Degree awarded on June 2016

Advisor: **Tomasz Kornuta**

K.Katerżawa
Wykorzystanie podejścia opartego na testach do budowy podsystemów percepcji robotów
Degree awarded on September 2016

Advisor: **Adam Kozakiewicz**

S.Wijas
Automatyczne generowanie sygnatur robaków sieciowych z wykorzystaniem drzewa decyzyjnego
Degree awarded on December 2016

W.Majewski (OKNO)
Analiza porównawcza ilości i rozmieszczania punktów dostępowych w sieciach zasięgowych oraz pojemnościowych na podstawie modeli teoretycznych i empirycznych propagacji fal radiowych w środowisku wewnątrz budynkowym
Degree awarded on Frebruary 2016

Advisor: **Tomasz Kruk**

A.Papros
Wysoce wydajna warstwa pośrednia jako przykład zastosowania nowoczesnych mechanizmów synchronizacyjnych
Degree awarded on March 2016

Advisor: **Adam Krzemienowski**

A.Prus
Rozkład najgorszego przypadku w modelowaniu stóp zwrotu portfela inwestycyjnego
Degree awarded on March 2016 (with honors)

M.Draps
Wpływ błędów estymacji warunkowej wartości zagrożonej na strukturę portfela inwestycyjnego
Degree awarded on March 2016

M.Kędrzyński
Konstrukcja portfela inwestycyjnego z miarą ryzykowności Fostera-Harta
Degree awarded on October 2016 (with honors)

Advisor: **Piotr Marusak**

P.Bazydło
Algorytmy regulacji predykcyjnej bazującej na modelach strukturyzowanych z rozmytą dynamiką i rozmytą statyką
Degree awarded on June 2016 (with honors)

K.Czerwiński
Dostrajanie analitycznych regulatorów rozmytych z zachowaniem stabilności układu regulacji
Degree awarded on September 2016 (with honors)

Advisor: **Marek Nałęcz (ISE)**

A.Rogowiec
Opracowanie równoległej wersji algorytmu estymacji grani funkcji gęstości wielowymiarowej zmiennej losowej i jego implementacja w środowisku CUDA
Degree awarded on October 2016

Advisor: **Ewa Niewiadomska-Szynkiewicz**

W.Kaczorowski
System sterowania oswietleniem LED
Degree awarded on May 2016

P.Okuła
Zbieranie danych pomiarowych z bezprzewodowej sieci czujników i ich wizualizacja na urządzeniu mobilnym
Degree awarded on March 2016

Ł.Gawroński
Energooszczędne i bezpieczne trasowanie komunikatów w bezprzewodowej sieci sensorowej
Degree awarded on March 2016

Advisor: **Piotr Pałka**

M.Strankowski
Analiza algorytmów pszczelego i mrówkowego w ujęciu systemu wieloagentowego dla problemu TSP-TW
Degree awarded on March 2016

R.Krupiński
Analiza algorytmów pszczelego i mrówkowego w ujęciu systemu wieloagentowego dla problemu TSP-TW
Degree awarded on March 2016

M.Witt
Metody alokacji honeypotów w sieciach komputerowych
Degree awarded on March 2016

Ł.Tkacz (OKNO)
Wydajne techniki wyszukiwania ścieżek dla agentów sztucznej inteligencji w grach komputerowych
Degree awarded on June 2016

I.Plasota
Zarządzanie poborem energii elektrycznej w inteligentnym domu HAN przy zastosowaniu taryf wielostrefowych i RTP
Degree awarded on October 2016

A.Smoleń
Uczenie ze wzmocnieniem w kooperacyjnym systemie wieloagentowym w zastosowaniu aukcji dwustronnej
Degree awarded on October 2016

Advisor: **Andrzej Ratkowski**

B.Pietroń
Architektura przedsięwzięcia informatycznego i analiza problemów w wytwarzaniu oprogramowania według autorskiej metodyki AMG.net PM WAY
Degree awarded on October 2016

Advisor: **Magdalena Szeżyńska (ISE)**

L.Borkowski
Identyfikacja, zabezpieczanie, analiza i prezentacja dowodów elektronicznych pochodzących z heterogonicznych, rozbudowanych systemów i sieci teleinformatycznych na potrzeby informatyki śledczej
Degree awarded on June 2016

Advisor: **Marcin Szlenk**

J.Gonera
Wzorce projektowe w programowaniu funkcyjnym
Degree awarded on March 2016

Advisor: **Eugeniusz Toczyłowski**

C.Kowalczyk
Optymalizacja lokalizacji węzłów przeładunkowych w kontekście sieci wartości
Degree awarded on March 2016

Advisor: **Piotr Tatjewski**

R.Ugodziński
Metody estymacji stanu w algorytmach regulacji predykcyjnej
Degree awarded on March 2016

Advisor: **Paweł Wawrzyński**

M.Kubiak
Porównanie nieklasycznych metod uczenia się sieci neuronowych on-line
Degree awarded on March 2016

I.Antonowicz
Porównanie nieklasycznych metod uczenia się sieci neuronowych on-line
Degree awarded on March 2016

Advisor: **Tomasz Winiarski**

B.Świstak
Stanowisko badawcze do modelowania, identyfikacji i regulacji napędów manipulatorów
Degree awarded on January 2016

Advisor: **Marcin Witkowski (Wydział Mechatroniki)**

M.Panek
Środowisko programistyczne do optymalizacji przy wykorzystaniu algorytmów inteligencji masowej
Degree awarded on October 2016

Advisor: **Andrzej Zalewski**

M.Purwin
Metoda oceny architektury aplikacji mobilnych
Degree awarded on March 2016

M.Gula
Metoda oceny i analizy aplikacji usługowych
Degree awarded on June 2016

Advisor: **Izabela Żółtowska**

A.Sauer
Możliwości wykorzystania technologii .NET Micro Framework w automatyce przemysłowej
Degree awarded on October 2016

5.3 B.Sc. Degrees

Advisor: **Adam Czajka**

E.Bartuzi
Rozpoznawanie tożsamości przy wykorzystaniu obrazów termicznych dłoni
Degree awarded on January 2016 (Wydział Mechatroniki)

K.Michowska
Budowa binarnego kodu podpisu on-line
Degree awarded on January 2016 (Wydział Mechatroniki)

Advisor: **Krzysztof Cabaj (II)**

P.Łucka
System wstępnego grupowania pobranego z sieci złośliwego oprogramowania
Degree awarded on February 2016

Advisor: **Piotr Gawkowski (II)**

A.Kosik
System analizy złośliwego oprogramowania w systemie Windows
Degree awarded on February 2016

Advisor: **Janusz Granat**

F.Gralewski
System wspomagania decyzji w obszarze obrotu gotówkowego banku
Degree awarded on February 2016

Advisor: **Jerzy Gustowski**

P.Pawlukiewicz
Porównanie różnych technik programowania sterowników rodziny SIMATIC
Degree awarded on February 2016

A.Słoma
System wizualizacji procesów w telefonie komórkowym
Degree awarded on February 2016

Ł.Sieńko
Oprogramowanie sterujące modelu fizycznego wielostanowiskowej linii produkcyjnej
Degree awarded on February 2016

Ł.Kowalczyk
Aplikacja do eksportu alarmów procesowych generowanych przez profesjonalny program typu SCADA (WinCC firmy Siemens)
Degree awarded on July 2016

Advisor: **Mariusz Kaleta**

W.Oksiński
Narzędzie informatyczne wspomagające zarządzanie portfelem projektów
Degree awarded on February 2016

M.Kedroń
Symulacja zdarzeniowa linii produkcyjnej
Degree awarded on February 2016

M.Frankowski
System planowania zleceń produkcyjnych w chmurze
Degree awarded on September 2016

B.Kulas
Rozwój funkcjonalności programu Modgraf
Degree awarded on September 2016

Advisor: **Mariusz Kamola**

M.Nowotnik
Prototyp dedukcyjnej bazy danych opartej na języku regułowym 4QL
Degree awarded on October 2016

Advisor: **Włodzimierz Kasprzak**

P.Woźniak
Algorytmy separacji i lokalizacji mówców w sygnałach audio
Degree awarded on September 2016

Advisor: **Adam Kozakiewicz**

M.Zaborski
Zabezpieczenie domowego routera bezprzewodowego
Degree awarded on February 2016

B.Dobrzyńska
Karta inteligentna jako zabezpieczenie DRM materiałów multimedialnych
Degree awarded on December 2016

Advisor: **Ewa Niewiadomska Szynkiewicz**

R.Białobrzeski
System generujący improwizacje muzyczne z wykorzystaniem algorytmu genetycznego
Degree awarded on September 2016

Advisor: **Włodzimierz Ogryczak**

R.Braun
Wspomaganie konstrukcji portfeli przekraczających wyniki średnie
Degree awarded on September 2016

Advisor: **Andrzej Pacut**

K.Otto
Wykorzystanie modeli grafowych do ekstrakcji danych z faktur
Degree awarded on September 2016

Ł.Butryn
Analiza podpisu offline z wykorzystaniem marszczenia czasu
Degree awarded on September 2016

Advisor: **Krzysztof Pieńkosz**

J.Dróżdż
Dekompozycja połączeń teleinformatycznych na ścieżki z jak najmniejszą liczbą węzłów
Degree awarded on September 2016

Advisor: **Andrzej Ratkowski**

P.Łada
Aplikacja wspomagająca zarządzanie zakupami spożywczymi wykorzystująca infrastrukturę Google APP Engine
Degree awarded on February 2016

W.Klimczak
Analiza porównawcza narzędzi wspomagających proces wytwarzania oprogramowania
Degree awarded on Frebruary 2016

M.Gańko
System w infrastrukturze Google App Engine zintegrowany z aplikacją mobilną
Degree awarded on Frebruary 2016

Advisor: **Jerzy Sobczyk**

R.Wądołowski
System zarządzania heterogenicznym środowiskiem stacji roboczych
Degree awarded on February 2016

M.Jędrzejewski
Propozycja modernizacji serwisu informacyjno-dydaktycznego dla studentów Wydziału EiTI
Degree awarded on September 2016

Advisor: **Andrzej Stachurski**

A.Skoniecka
System wspomagania decyzji przy zakupie środków ochrony roślin w systemie ANDROID
Degree awarded on Frebruary 2016

D.Koźlak
Aplikacja wspomagająca zakupy sprzętu pszczelarskiego w systemie operacyjnym ANDROID
Degree awarded on September 2016

Advisor: **Tomasz Śliwiński**

P.Malijewski
Metody alokacji produktów w rozproszonym systemie handlowym
Degree awarded on February 2016

Advisor: **Paweł Wawrzyński**

K.Frydlewicz
Wspomaganie obliczeń w sieciach neuronowych przy użyciu technologii CUDA i bibliotek numerycznych
Degree awarded on February 2016

R.Jagielski
Wykorzystanie modelu w nauczaniu ze wzmocnieniem na przykładzie chodzącego robota humanoidalnego
Degree awarded on Septeber 2016

Advisor: **Tomasz Winiarski**

M.Węgierek
Stanowisko badawcze do analizy działania serwomechanizmu wizyjnego dla manipulatora IRp-6
Degree awarded on February 2016

M.Safarzyński
Przegląd środowisk programistycznych dla LEGO Mindstorms EV3, z weryfikacją robotem układającym Kostkę Rubika
Degree awarded on June 2016

P.Wąsowski
Układanie wież Hanoi z wykorzystaniem robota manipulacyjnego IRp-6
Degree awarded on June 2016

M.Lotz
Robot IRp-6 w zadaniu śledzenia konturu
Degree awarded on June 2016

Advisor: **Andrzej Zalewski**

A.Sadowski
Aplikacja mobilna do edycji katalogów do gier bitewnych w technologii Xamarin
Degree awarded on February 2016

K.Lisocki
Zaprojektowanie i wdrożenie systemu ewidencji zleceń w małej firmie eksperckiej
Degree awarded on September 2016

6 Publications

6.1 Scientific or Technical Books and Chapters

[B1] K. Billewicz, D. Bober, M. Jabłońska, I. Żółtowska, and M. Chyl-Flicińska, "Inteligentne sieci elektroenergetyczne – wybrane aspekty". Warszawa: Texter, 2016.

[B2] K. Banachowicz, D. Seredyński, and T. Winiarski, "Trójosiowy pomiar siły kontaktu w paliczkach chwytaka", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 335–344.

[B3] A. Czajka, "Iris Liveness Detection by Modeling Dynamic Pupil Features", in *Kevin W. Bowyer, Mark J. Burge (Eds.), Handbook of Iris Recognition, chapter 19*, Second Edition, Springer-Verlag London, 2016, pp. 439–467

[B4] W. Dudek, W. Szynkiewicz, and T. Winiarski, "Wieloagentowy system nawigacji robotów usługowych wspomagany chmurą obliczeniową", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 245–254.

[B5] M. Figat and C. Zieliński, "Metoda specyfikacji robota-kompana", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 39–50.

[B6] M. Kaleta, P. Pałka, and I. Żółtowska, "Agregator aktywnych odbiorców z perspektywy europejskich projektów sieci inteligentnych", in *Rynek energii elektrycznej: rozwój i funkcjonowanie rynków energii*, Z. Połecki and P. Pijarski, Eds. Politechnika Lubelska, 2016, pp. 41–50.

[B7] M. Karpowicz, E. Niewiadomska-Szynkiewicz, P. P. Arabas, and A. Sikora, "Energy and power efficiency in cloud", in *Resource Management for Big Data Platforms. Algorithms, Modelling, and High-Performance Computing Techniques*, F. Pop, J. Kołodziej, and B. Di Martino, Eds. Springer International Publishing, 2016, pp. 97–127.

[B8] T. M. Kornuta and M. Stefańczyk, "Porównanie metod akwizycji obrazów RGB-D na potrzeby rejestracji trójwymiarowych modeli obiektów", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 357–366.

[B9] M. Laszkowski and T. M. Kornuta, "Porównanie metod weryfikacji hipotez obiektów rozpoznawanych w obrazach RGB-D", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 367–376.

[B10] A. Prus and K. Pieńkosz, "Szeregowanie zadań częściowo podzielnych na procesorach równoległych", in *Automatyzacja procesów dyskretnych. Teoria i zastosowania*, A. Świerniak and J. Krystek, Eds. Politechnika Śląska, 2016, vol. I, pp. 249–255.

[B11] D. Seredyński, K. Banachowicz, and T. Winiarski, "Metody pomiaru siły kontaktu w trójpalczastym chwytaku barrethand", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 345–354.

[B12] M. Stefańczyk and M. Walęcki, "Konstrukcja stolika obrotowego do celów akwizycji widoków do baz obiektów", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 447–455.

[B13] B. Świstak and T. Winiarski, "Sterowanie pozycyjno-impedancyjne zmodyfikowanym przemysłowym manipulatorem IRP6 – część druga, sterowanie momentem zespołu napędowego z kompensacją sił tarcia", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 71–80.

[B14] P. Tatjewski, "Sterowanie zaawansowane obiektów przemysłowych. Struktury i algorytmy. Wydanie drugie zmienione". Warszawa: Akademicka Oficyna Wydawnicza EXIT Andrzej Lang, 2016.

[B15] K. Tchoń and C. Zieliński, Eds., *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195.

[B16] T. Winiarski and B. Świstak, "Sterowanie pozycyjno-impedancyjne zmodyfikowanym przemysłowym manipulatorem IRP6 – część pierwsza, struktura sterownika", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 61–70.

[B17] C. Zieliński, W. Szynkiewicz, W. Kasprzak, M. Stefańczyk, M. Figat, W. Dudek, J. Figat, M. Szlenk, and T. Zielińska, "Sterowniki o zmiennej strukturze w zastosowaniu do robotów społecznych", in *Postępy Robotyki. Tom I i II*, ser. Prace Naukowe Politechniki Warszawskiej. Elektronika, K. Tchoń and C. Zieliński, Eds. Oficyna Wydawnicza Politechniki Warszawskiej, 2016, no. 195, pp. 5–14.

[B18] I. Żółtowska, "Agregator floty pojazdów elektrycznych", in *Inteligentne sieci elektroenergetyczne – wybrane aspekty*, K. Billewicz, D. Bober, M. Jabłońska, I. Żółtowska, and M. Chyl-Flicińska, Eds. Texter, 2016, pp. 43–61.

[B19] I. Żółtowska, "Problemy i metody zarządzania flotą pojazdów elektrycznych", in *Inteligentne sieci elektroenergetyczne – wybrane aspekty*, K. Billewicz, D. Bober, M. Jabłońska, I. Żółtowska, and M. Chyl-Flicińska, Eds. Texter, 2016, pp. 27–41.

6.2 Scientific and Technical Papers in Journals

[J1] P. P. Arabas and M. Karpowicz, "Częstość występowania wybranych triad w sieci połączeń między systemami autonomicznymi jako wskaźnik niektórych typów anomalii ruchu", *Przegląd Telekomunikacyjny – Wiadomości Telekomunikacyjne*, no. 8–9 2016, pp. 1179–1184, 2016.

[J2] P. P. Arabas and M. Karpowicz, "Wykorzystanie informacji z rejestrów procesora do identyfikacji modelu poboru mocy przez serwer", *Przegląd Elektrotechniczny*, no. 3, pp. 34–41, 2016.

[J3] A. Czajka, W. Kasprzak, and A. Wilkowski, "Verification of iris image authenticity using fragile watermarking", *Bulletin of the Polish Academy of Sciences, Technical Sciences*, vol. 46, no. 4, pp. 807–819, 2016.

[J4] P. Domański, S. Golonka, R. Jankowski, P. Kalbarczyk, and B. Moszowski, "Control rehabilitation impact on production efficiency of ammonia synthesis installation", *Industrial & Engineering Chemistry Research*, vol. 55, pp. 10 366–10 376, 2016.

[J5] P. Domański, "Non-gaussian and persistence measures for control loop quality assessment", *Chaos*, vol. 26, no. 4, pp. 0 431 051–04 310 518, 2016.

[J6] W. Gruszczyński and P. P. Arabas, "Application of social network inferred data to churn modeling in telecoms", *Journal of Telecommunications and Information Technology*, no. 2, pp. 77–86, 2016.

[J7] G. Guastaroba, R. Mansini, W. Ogryczak, and M. Grazia Speranza, "Linear programming models based on Omega ratio for the enhanced index tracking problem", *European Journal of Operational Research*, vol. 251, no. 3, pp. 938–956, 2016.

[J8] P. Jaskóła, P. P. Arabas, and A. Karbowski, "Simultaneous routing and flow rate optimization in energy-aware computer networks", *International Journal of Applied Mathematics & Computer Science*, vol. 26–2016, no. 1, pp. 231–243, 2016.

[J9] P. M. Jaskóła and A. Karbowski, "Efektywne metody jednoczesnego wyznaczania optymalnego routingu i przydziału pasma w sieci", *Przegląd Telekomunikacyjny – Wiadomości Telekomunikacyjne*, no. 8–9/2016, pp. 947–951, 2016.

[J10] A. Karbowski and P. Jaskóła, "New developments in a two-criteria approach to dynamic power management in energy-aware computer networks", *Journal of Telecommunications and Information Technology*, no. 2/2016, pp. 21–25, 2016.

[J11] M. Karpowicz and P. P. Arabas, "Server workload model identification: monitoring and control tools for linux", *Journal of Telecommunications and Information Technology*, no. 2, pp. 5–12, 2016.

[J12] A. A. Krzemienowski and S. Szymczyk, "Portfolio optimization with a copula-based extension of conditional value-at-risk", *Annals of Operations Research*, vol. 237, no. 1, pp. 219–236, 2016.

[J13] A. A. Krzemienowski, "Zastosowanie rozkładu najgorszego przypadku do konstrukcji stabilnego portfela inwestycji finansowych", *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, vol. 2015, no. 248, pp. 150–160, 2016.

[J14] M. Krzysztoń and E. Niewiadomska-Szynkiewicz, "Heavy gas cloud boundary estimation and tracking using mobile sensors", *Journal of Telecommunications and Information Technology*, no. 3–2016, pp. 38–49, 2016.

[J15] M. Ławryńczuk, "Modelling and predictive control of a neutralisation reactor using sparse support vector machine Wiener models", *Neurocomputing*, vol. 2016, no. 205, pp. 311–328, 2016.

[J16] M. Ławryńczuk, "Nonlinear predictive control of dynamic systems represented by Wienerhammerstein models", *Nonlinear Dynamics*, vol. 86, no. 2, pp. 1193–1214, 2016.

[J17] E. Niewiadomska-Szynkiewicz, A. Sikora, and M. Marks, "A movement-assisted deployment of collaborating autonomous sensors for indoor and outdoor environment monitoring", *Sensors*, vol. 16, no. 9, pp. 1–21, 2016.

[J18] E. Niewiadomska-Szynkiewicz, M. Kamola, P. P. Arabas, and A. Sikora, "Energy-saving algorithms for the control of backbone networks: A survey", *Journal of Telecommunications and Information Technology*, no. 2/2016, pp. 13–20, 2016.

[J19] W. Ogryczak and P. Olender, "Ordered median problem with demand distribution weights", *Optimization Letters*, vol. 10, no. 5, pp. 1071–1086, 2016.

[J20] P. Pałka, "Baza danych w problemie koordynacji agentów za pomocą algorytmów uczenia ze wzmocnieniem", *Studia Informatica*, vol. 37, no. 1(123), pp. 163–173, 2016.

[J21] M. J. Peryt and T. Traczyk, "EqDb – equipment database for complex experiments", *Acta Physica Polonica B Proceedings Supplement*, vol. 9(2016), no. 2, pp. 293–298, 2016.

[J22] S. Reppou, E. G. Tsardoulias, A. Kintsakis, A. L. Symeonidis, P. A. Mitkas, F. Psomopoulos, G. Karagiannis, C. Zieliński, V. Prunet, J. Merlet, M. Iturburu, and A. Gkiokas, "RAPP: A robotic-oriented ecosystem for delivering smart user empowering applications for older people", *International Journal of Social Robotics*, vol. 8, no. 4, pp. 539–552, 2016.

[J23] K. Sacha, "On the semantics of architectural decisions", *International Journal of Software Engineering and Knowledge Engineering*, vol. 26, no. 2, pp. 333–346, 2016.

[J24] M. Trokielewicz, E. Bartuzi, "Cross-spectral Iris Recognition for Mobile Applications using High-quality Color Images", *Journal of Telecommunications and Information Technology*, no. 3/2016, pp. 91–97.

[J25] A. Wilkowski, T. M. Kornuta, W. Kasprzak, and M. Stefańczyk, "Efficient generation of 3D surfel maps using RGB-D sensors", *International Journal of Applied Mathematics & Computer Science*, vol. 26, no. 1, pp. 99–122, 2016.

[J26] A. Wysocki and M. Ławryńczuk, "Elman neural network for modeling and predictive control of delayed dynamic systems", *Archives of Control Sciences*, vol. 26(LXII), no. 1, pp. 117–142, 2016.

[J27] G. Zalewski and W. Ogryczak, "Comparison of selected fair-optimization methods for flow maximization between given pairs of nodes in telecommunications network", *Journal of Telecommunications and Information Technology*, no. 3/2016, pp. 18–24, 2016.

[J28] G. Zalewski and W. Ogryczak, "Network dimensioning with maximum revenue efficiency for the fairness index", *Journal of Telecommunications and Information Technology*, no. 4/2016, pp. 15–21, 2016.

[J29] I. Żółtowska, "Demand shifting bids in energy auction with non-convexities and transmission constraints", *Energy Economics*, vol. 53, pp. 17–27, 2016.

[J30] I. Żółtowska, "Direct minimum-uplift model for pricing pool-based auction with network constraints", *IEEE Transactions on Power Systems*, vol. 31, no. 4, pp. 2538–2545, 2016.

6.3 Scientific and Technical Papers in Books and Conference Proceedings

[P1] P. Bazydło, E. Niewiadomska-Szynkiewicz, K. Czerwiński, and P. Rękawek, "Simulation-based design of mobile ad hoc network for tracking and monitoring", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 573–586.

[P2] P. Chaber and M. Ławryńczuk, "Auto-generation of advanced control algorithms' code for microcontrollers using transcompiler", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 454–459.

[P3] P. Chaber and M. Ławryńczuk, "Effectiveness of PID and DMC control algorithms automatic code generation for microcontrollers: Application to a thermal process", in *2016 3rd International Conference on Control and Fault-Tolerant Systems (SysTol)*, R. Sarrate, Ed. IEEE, 2016, pp. 618–623.

[P4] P. Chaber, "Implementation of dynamic matrix control algorithm using a microcontroller with fixed-point arithmetic", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 51–61.

[P5] P. Domański, "Fractal measures in control performance assessment", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 448–453.

[P6] W. Dudek, K. Banachowicz, W. Szynkiewicz, and T. Winiarski, "Distributed NAO robot navigation system in the hazard detection application", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 942–947.

[P7] W. Dudek, W. Szynkiewicz, and T. Winiarski, "NAO robot navigation system structure development in an agent-based architecture of the RAPP platform", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 623–633.

[P8] J. Figat and W. Kasprzak, "Incremental version space merging approach to 3D object model acquisition for robot vision", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 561–571.

[P9] T. Janiuk and P. Domański, "Evaluation of high efficiency operating rules for grate-fired boilers", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 257–266.

[P10] K. Koniuszewski and P. Domański, "Gradient approach to curve fitting with incomplete data", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 277–286.

[P11] K. Koniuszewski and P. Domański, "Practical aspects of Hammerstein models for nonstationary and nonlinear processes", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 103–113.

[P12] K. Koniuszewski and P. Domański, "Reproduction of equipment wear characteristics with Kernel regression", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 912–917.

[P13] T. M. Kornuta and M. Laszkowski, "Perception subsystem for object recognition and pose estimation in RGB-D images", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 597–607.

[P14] T. M. Kornuta and M. Stefańczyk, "Utilization of textured stereovision for registration of 3D models of objects", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 1088–1093.

[P15] M. Krzysztoń, "Comparison of MANET self-organization methods for boundary detection/tracking of heavy gas cloud", in *Proceedings of the 2016 Federated Conference on Computer Science and Information Systems*, ser. Annals of Computer Science and Information Systems, M. Ganzha, L. A. Maciaszek, and M. Paprzycki, Eds., vol. 5. IEEE, 2016, pp. 1075–1084.

[P16] M. Krzysztoń and E. Niewiadomska-Szynkiewicz, "Mobile ad hoc network for a heavy gas cloud boundary estimation and tracking", in *21st International Conference on Methods and Models in Automation and Robotics. Book of Abstracts*. Faculty of Electrical Engineering, 2016, pp. 1004–1009.

[P17] D. Latocha and P. P. Arabas, "Multi-agent system for on-line game matchmaking", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 245–256.

[P18] M. Ławryńczuk, "An easily trained neural model of a distributed parameter system", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 674–679.

[P19] M. Ławryńczuk, "Neural modelling of a yeast fermentation process using extreme learning machines", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 13–23.

[P20] M. Ławryńczuk, "Nonlinear predictive control of temperature in long duct using specially designed neural model", in *2016 3rd International Conference on Control and Fault-Tolerant Systems (SysTol)*, R. Sarrate, Ed. IEEE, 2016, pp. 281–286.

[P21] M. Łępicka, T. M. Kornuta, and M. Stefańczyk, "Utilization of colour in ICP-based point cloud registration", in *Proceedings of the 9th International Conference on Computer Recognition Systems CORES 2015*, R. Burduk, K. Jackowski, M. Kurzyński, and M. Woźniak, Eds. Springer International Publishing, 2016, pp. 821–830.

[P22] M. Marks and E. Niewiadomska-Szynkiewicz, "Simulation of robot-assisted WSN localization using real-life data", in *Proceedings 30th European Conference on Modelling and Simulation ECMS 2016*, T. Claus, F. Herrmann, M. Manitz, and O. Rose, Eds. Digitaldruck Pirrot GmbH, 2016, pp. 607–613.

[P23] P. Marusak, "Output constraint handling in analytical MPC algorithms based on Hammerstein models with presumed trajectory of future control changes", in *Challenges in*

Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 351–361.

[P24] E. Niewiadomska-Szynkiewicz and J. Błaszczyk, "Simulation-based optimization methods applied to large scale water systems control", in *Ubiquitous Intelligence & Computing, Advanced and Trusted Computing, Scalable Computing and Communications, Cloud and Big Data Computing, Internet of People, and Smart World Congress (UIC/ATC/ScalCom/CBDCom/IoP/SmartWorld), 2016 Intl IEEE Conferences*, D. El Baz and J. Bourgeois, Eds. IEEE, 2016, pp. 649–656.

[P25] P. Pałka, T. Śliwiński, T. Traczyk, and W. Ogryczak, "Persistence management in digital document repository", in *Beyond Databases, Architectures and Structures. Advanced Technologies for Data Mining and Knowledge Discovery*, ser. Communications in Computer and Information Science, S. Kozielski, D. Mrozek, P. Kasprowski, B. Małysiak-Mrozek, and D. Kostrzewa, Eds., vol. 613. Springer International Publishing, 2016, pp. 668–682.

[P26] K. Przerwa, W. Kasprzak, and M. Stefańczyk, "Infrared image-based 3D surface reconstruction of free-form texture-less objects", in *Proceedings of the 9th International Conference on Computer Recognition Systems CORES 2015*, R. Burduk, K. Jackowski, M. Kurzyński, and M. Woźniak, Eds. Springer International Publishing, 2016, pp. 809–820.

[P27] D. Seredyński, M. Stefańczyk, K. Banachowicz, B. Świstak, V. Kutia, and T. Winiarski, "Control system design procedure of a mobile robot with various modes of locomotion", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 490–495.

[P28] D. Seredyński and W. Szynkiewicz, "Fast grasp learning for novel objects", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 681–692.

[P29] D. Seredyński, K. Banachowicz, and T. Winiarski, "Graphbased potential field for the endeffector control within the torquebased task hierarchy", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 645–650.

[P30] M. Stefańczyk and R. Pietruch, "Hypothesis generation in generic, model-based object recognition system", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 717–727.

[P31] M. Stefańczyk, M. Laszkowski, and T. M. Kornuta, "WUT visual perception dataset: A dataset for registration and recognition of objects", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 635–645.

[P32] P. Tatjewski, M. Ławryńczuk, P. Marusak, M. Rubik, P. Ziętek, M. Szumski, and M. Szumski, "Design and implementation of the air/water heat pump controller with increased coefficient of performance", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 959–964.

[P33] M. Trokielewicz, A. Czajka and P. Maciejewicz, "Human Iris Recognition" in *Post-mortem Subjects: Study and Database, 8th IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS 2016)*, 6–9 September 2016, Niagara Falls, NY, USA, pp. 1–6.

[P34] M. Trokielewicz, A. Czajka, P. Maciejewicz, "Post-mortem Human Iris Recognition", in *9th IAPR International Conference on Biometrics (ICB 2016)*, June 13–16 2016, Halmstad, Szwecja, pp. 1–6.

[P35] M. Trokielewicz, "Iris Recognition with a Database of Iris Images Obtained in Visible Light Using Smartphone Camera", in *IEEE International Conference on Security and Behavior Analysis (ISBA 2016)*, 29 Feb.–2 March 2016, Sendai, Japonia, pp. 1-6

[P36] M. Walęcki and C. Zieliński, "Prediction-based visual servo control", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 693–704.

[P37] A. Wilkowski and M. Stefańczyk, "Detection and recognition of compound 3D models by hypothesis generation", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 659–668.

[P38] T. Winiarski, W. Kasprzak, M. Stefańczyk, and M. Walęcki, "Automated inspection of door parts based on fuzzy recognition system", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 478–483.

[P39] T. Winiarski, K. Banachowicz, M. Walęcki, and J. Bohren, "Multibehavioral positionforce manipulator controller", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 651–656.

[P40] A. Wojtulewicz, P. Chaber, and M. Ławryńczuk, "Multiple-input multiple-output laboratory stand for process control education", in *Proceedings of 21st IEEE Conference on Method and Models in Automation and Robotics*. IEEE Institute of electrical and Electronics Engineers, 2016, pp. 466–471.

[P41] A. Wojtulewicz and M. Radtke, "Wideband 4-diode sampling circuit", in *Proc. SPIE. 10031, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2016*, R. Romaniuk, Ed., vol. 10031. SPIE, 2016, pp. 100 311Z–1–100 311Z–9.

[P42] A. Wujek and T. Winiarski, "Automated drawing recognition and reproduction with a multisensory robotic manipulation system", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk,

M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 423–433.

[P43] A. Wysocki and M. Ławryńczuk, "Two- and three-layer recurrent elman neural networks as models of dynamic processes", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 165–175.

[P44] C. Zieliński and M. Figat, "Robot system design procedure based on a formal specification", in *Challenges in Automation, Robotics and Measurement Techniques. Proceedings of AUTOMATION-2016, March 2–4, 2016, Warsaw, Poland*, ser. Advances in Intelligent Systems and Computing, R. Szewczyk, M. Kaliczyńska, and C. Zieliński, Eds., vol. 440. Springer International Publishing, 2016, pp. 511–522.

6.4 Reports and Other Papers

[R1] G. Guastaroba, R. Mansini, W. Ogryczak, and M. Speranza, "Enhanced index tracking with CVaR-based measures", Research Report 2016–14, 2016.

[R2] A. A. Krzemienowski, J. Hurkała, and T. Śliwiński, "An empirical analysis of portfolio optimization models based on the robust risk measures and their non-robust counterparts", Research Report 2016–5, 2016.

[R3] M. Krzysztoń, "Scenariusze testowe wykorzystania sieci manet do śledzenia i wykrywania chmury gazów ciężkich", Research Report 2016–11, 2016.

[R4] M. Krzysztoń, "Wpływ konieczności zapewnienia spójności sieci manet w czasie realizacji zadania śledzenia i wykrywania kształtu chmury gazów ciężkich", Research Report 2016–01, 2016.

[R5] M. Ławryńczuk, W. Ogryczak, and T. Traczyk, "Analiza potrzeb i opracowanie struktury nowej strony internetowej iaiis do wspomagania badań naukowych i upowszechniania wyników", Research Report 2016–15, 2016.

[R6] M. Ławryńczuk, "Opracowanie treści do nowej strony internetowej iaiis do wspomagania badań i upowszechniania", Research Report 2016–16, 2016.

[R7] M. Przyłuski, "State-of-the-art testing of system on chip designs", Research Report 2016–06, 2016.

[R8] T. Traczyk, "Cyfrowe repozytorium dokumentów credo: Budowa i konfiguracja repozytorium realizującego funkcje archiwum długoterminowego", Research Report 2016–08, 2016.

[R9] T. Traczyk, "Cyfrowe repozytorium dokumentów CREDO: Dokumentacja techniczna podsystemów zarządzających archiwum", Research Report 2016–09, 2016.

[R10] T. Traczyk, "Cyfrowe repozytorium dokumentów CREDO: Dostosowanie projektu repozytorium do funkcji archiwum długoterminowego", Research Report 2016–07, 2016,

[R11] T. Winiarski, "A software to control a dual-arm system composed of two modified irp-6 manipulators", Research Report 2016–13, 2016.

[R12] T. Winiarski, “Baza obrazów testowych drzwi i zamków”, Research Report 2016–04, 2016.

[R13] T. Winiarski, D. Seredyński, and K. Banachowicz, “Bezpieczeństwo w sterowniku robota usługowego velma”, Research Report 2016–10, 2016.

[R14] T. Winiarski and W. Dudek, “Koncepcja integracji holonomicznej bazy mobilnej z robotem velma”, Research Report 2016–02, 2016.

[R15] T. Winiarski, “Platformy robotów sportowych do zawodów indywidualnych i zespołowych – raport końcowy”, Research Report 2016–17, 2016.

[R16] T. Winiarski, “Układ elektroniczny do akwizycji danych z jednostki inercyjnej za pośrednictwem ethercat”, Research Report 2016–03, 2016.