# Institute of Control and Computation Engineering

# 2013 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 Director*

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

The Institute offers courses in a broad area of information technology, concentrating on control and decision support systems, at three levels of education. At the first two levels (equivalent to B.Eng. and M.Eng.) the degree programs combine courses from the areas of computer science and control. We are also proud to offer interesting opportunities to our postgraduates, so that they can continue their study and research towards a Ph.D., either in Computer Science or in Control and Robotics. From the academic year 2007/2008, this standard educational offer has been supplemented by postgraduate studies in Management of Information Technology Resources and in Project Management organized by Dr. Andrzej Zalewski. There is a growing interest in this form of studies and above 150 persons took part in these courses in the 2012/2013 edition. Besides that our Institute, as the representative of the Faculty of Electronics and Information Technology, jointly with the Faculty of Power and Aeronautical Engineering started an Erasmus Mundus Masters Program in Robotics in 2007. The partners of Warsaw University of Technology in this Program are Ecole Centrale de Nantes (Nantes, France) – the coordinator and Universita Degli Studi di Genova (Genova, Italy). The students from within and outside of the EU study for two years, each year in one of the partner institutions and obtain a double diploma from those universities upon successful completion of the studies.

The Robot Programming and Pattern Recognition Group, started this year a 7th Framework Program Project RAPP – Robotic Applications for Delivery Smart User Empowering Applications (ITC-2013.5.3, grant no.610947). The partners of the project are: Centre for Research and Technology Hellas (CERTH, Greece)- the coordinator, Institute National de Recherche en Informatique et en Automatique (INRIA, France), Warsaw University of Technology (WUT, Poland), Sigma Orionis S.A. (France), Ortelio Ltd (United Kingdom), Idryma Ormylia (Greece) and Fundation Instituto Gerontologico Matia-Ingema (Spain). The project focuses the utilization of cloud computing and robots in the process of social inclusion of people facing exclusion.

In 2013 two new R&D projects within the EU Innovative Economy Operational Programme have been initiated. They are scheduled for the years 2013–2015. The Control Techniques Group headed by Prof. Piotr Tatjewski has started the project "Design and Construction of the Controller for the Air Water Heat Pump". The project is conducted with the industrial company PLUM, where the laboratory equipment containing heat pump is installed and where the designed controllers will be produced. The aim of the project is to design advanced model-based controllers, able to increase efficiency of the AW Heat pumps operation. The Optimization and Decision Support Group headed by Prof. Włodzimierz Ogryczak has initiated the project "Decision Support System for Large-Scale Periodic Vehicle Routing and Scheduling Problems with Complex Constraints" which is conducted to gether with SMT Software S.A. The aim of the project is the development of algorithms for large-scale periodic time-dependent vehicle routing and scheduling problems with complex constraints supporting planning and management of mobile personnel tasks.

The group headed by Prof. Ewa Niewiadomska-Szynkiewicz has concluded the project Low Energy Consumption NETworks (ECONET) within the 7th FP EU grant ICT-2009.1.1: The Network of the

Future (FP7-ICT-2009-5). The ECONET project focused its research and development efforts on the study of innovative techniques and architectural solutions to support energy efficiency in the next generation networks. The consortium consists of 14 partners (including WUT): Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Italy, the coordinator), Mellanox Technologies Ltd. (Israel), Alcatel-Lucent Italia S.p.A. (Italy), Lantiq (Germany), Ericsson Telecomunicazioni S.p.A. (Italy), Telecom Italia (Italy), Greek Research & Technology Network (Greece), NASK (Poland), Dublin City University (Ireland), VTT (Finland), NetVisor (Hungary), Ethernity Networks Ltd (Israel), LightComm S.r.l. (Italy), Infocom (Italy).

In the year 2013 Prof. Andrzej Pacut coordinated the project on "Biometrics techniques and PKI for modern ID documents securing of and information systems" granted by the National Centre for Research and Development (NCBiR) involving NASK, WUT, ASSECO Poland S.A., Trusted Information Consulting Ltd. and University of Wrocław. Within ICCE Prof. Włodzimierz Kasprzak led the team of biometrics and pattern recognition groups.

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 Dr. Maciej Ławryńczuk, Dr. Tomasz Traczyk and Dr. Joanna Putz-Leszczyńska who have been awarded by the Rector of Warsaw University of Technology.

*Cezary Zieliński*

# Contents

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# 1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2013.

## 1.1 Directors

Professor Cezary Zieliński, Director
Professor Włodzimierz Ogryczak, 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, T. Kornuta, A. Kozakiewicz, T.J. Kruk, B. Kubica, J. Putz-Leszczyńska, Wojciech Szynkiewicz, Paweł Wawrzyński, Tomasz Winiarski, A. Woźniak |
| *Assistant:* | M. Walęcki |
| *Senior Lecturer:* | M. Warchoł |
| *Ph.D. Students:* | P.H. Ekes, K.S. Daniluk, J. Figat, M. Figat, W. Gutfeter, A. Igielski, K. Lasota, J.P. Olczak, B. Papis, K. Piech, P. Przybysz, D. Seredyński, K. Siudek, M. Stefańczyk, M. Walęcki |
| *Software Engineers:* | M. Walęcki |

Research of the division is conducted in 3 research groups:

**Complex Systems Group** (**E. Niewiadomska-Szynkiewicz**, K. Malinowski, P. Arabas, M. Kamola, A. Karbowski, A. Kozakiewicz, T.J. Kruk, B. Kubica, A. Woźniak, M. Warchoł, K. Daniluk, K. Lasota)

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**, M. Chochowski (until. Sept. 2013), A. Czajka, J. Putz-Leszczyńska, P. Wawrzyński, W. Gutfeter, J. Olczak, B. Papis, K. Piech)

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**, W. Kasprzak, T. Kornuta, W. Szynkiewicz, M. Walęcki, T. Winiarski, P.H. Ekes, J. Figat, M. Figat, P. Przybysz, D. Seredyński, K. Siudek, M. Stefańczyk )

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:* | K. Sacha, P. Tatjewski |
| *Assistant Professors:* | P. Domański, M. Ławryńczuk, P. Marusak, M. Szlenk, A. Zalewski, A. Ratkowski |
| *Senior Lecturers:* | J. Gustowski, U. Kręglewska |
| *Senior Engineer:* | W. Macewicz |
| *Ph.D. Students:* | A. Hurkała, S. Kijas, W. Pikulski, M. Szumski, M. Romanowski, A. Wysocki |

Research of the division is conducted in 2 research groups:

**Control Engineering Group** (**P. Tatjewski**, P. Domański, M. Ławryńczuk, P. Marusak, J. Gustowski, U. Kręglewska, M. Szumski, A. Wysocki)

Research of the group encompasses control engineering techniques, in particular industrial process control. The focus is on predictive control algorithms, multilayer optimizing and supervisory control, and non-linear system control and analysis. Model-based predictive control algorithms for linear and nonlinear process modeling are developed and investigated. Soft computing methods for design and tuning of control systems are used, based first of all on neural nets and fuzzy systems. Theoretical considerations are combined with simulation analysis and investigations. Computer Control Systems Laboratory is equipped with programmable controllers, industrial computers and workstations with software tools, including Matlab with Toolboxes and SCADA systems.

**Software Engineering Group** (**K. Sacha**, M. Szlenk, W. Zalewski, A. Ratkowski, A. Hurkała, S. Kijas, W. Pikulski, M. Romanowski)

The main area of interest is the development and quality evaluation of software. Topics include software processes, software analysis and design methods, and quality evalua-tion. A new research area, partially supported by the Polish Ministry of Science and Higher Education, is methodology for the development and evolution of service-oriented (SOA) systems. Part of this research is aimed at addressing security issues in distributed applications by means of trust management services.

### Operations and Systems Research Division

| | |
|---|---|
| *Division Head:* | Professor E. Toczyłowski |
| *Professors:* | W. Ogryczak, E. Toczyłowski |
| *Professor, retired:* | W. Traczyk, A. P. Wierzbicki |
| *Readers:* | T. Traczyk |
| *Assistant Professors:* | J. Granat, M. Kaleta, K. Kołtyś, B. Kozłowski, A. Krzemienowski, P. Pałka, K. Pieńkosz, G. Płoszajski, A. Stachurski, T. Śliwiński, I. Żółtowska |
| *Senior Lecturers:* | T. Rogowski (until. Nov. 2013), J. Sobczyk |
| *Ph.D. Students:* | J. Hurkała, T. Jastrzębski, R. Karpuk, A. Mościcka, P. Modliński, P. Olender, A. Połomski, M. Przyłuski, K. Sędrowicz |

Research of the division is conducted in 2 research groups:

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

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, T. Rogowski (until. Nov. 2013), J. Sobczyk, A. Stachurski, T. Śliwiński, J. Hurkała, A. Mościcka, P. Olender, A. Połomski, M. Przyłuski)

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

### Complex Systems Group

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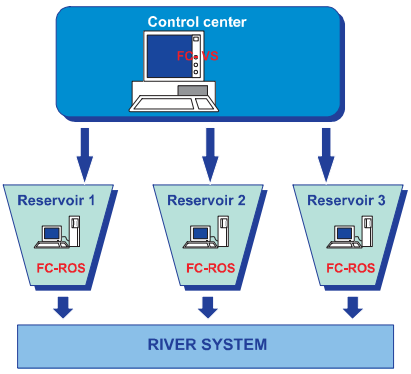
#### Software for complex systems simulation

**Flood Control**

**FC-ROS & FC-VS (*Flood Control*)**

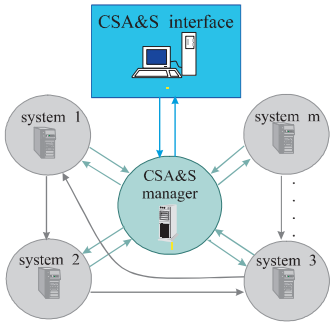
decision support systems for flood control in multireservoir systems.




**Distributed Simulation**

**CSA&S (*Complex Systems Analysis & Simulation*)**

heterogeneous software environment providing a framework for simulation experiments carried out on parallel computers.




**ASim/Java (*Asynchronous Simulation/Java*)**

library that may be used to build parallel or distributed discrete event simulators

### Complex Systems Group

Instytut Automatyki i Informatyki Stosowanej

#### Traffic control in TCP/IP networks

**Family of price-based control algorithms for IP networks**

**Congestion control:**
- New algorithm proposed
- Verified through simulations

Joint traffic engineering / bandwidth allocation methodology - designed to improve effectiveness (under investigation).

**Simulation Tools**

**TcpSim – a fast TCP/IP simulator:**
- calculation of transmission times for bulk data transfers
- flow-based - much faster than packet-level simulators
- original method of traffic modeling
- implemented in Java.

**BrokerSim – a C++ pricing simulation package for OPNET:**
- traffic generator for user profiles
- short-term traffic demand approximator
- broker module: pricing decisions and traffic shaping
- router pricing module augmenting OPNET's router model

## Complex Systems Group

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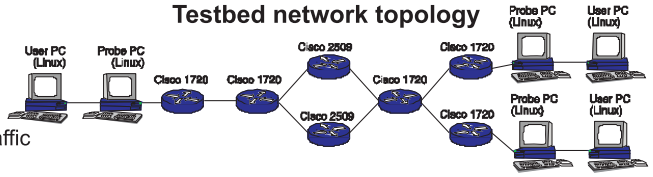
### Dynamic contracting of IP services

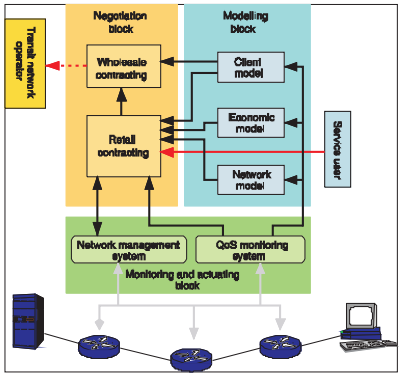
**System features:**

- small latency guarantees for RT traffic
- bandwidth guarantees for nRT traffic

**Testbed network topology**




**System architecture**




**Implementation - technologies:**

- Cisco *CBWFQ* (class-bases weighted fair queuing), *shaping*, *policing* used
- Monitoring and actuating block implementated in *PERL* using *command-line* access
- a dedicated control and measurements network used, *Precision Time Protocol* applied
- traffic generation and measurements tools: *bulk*, improved *DBS*

## Complex Systems Group

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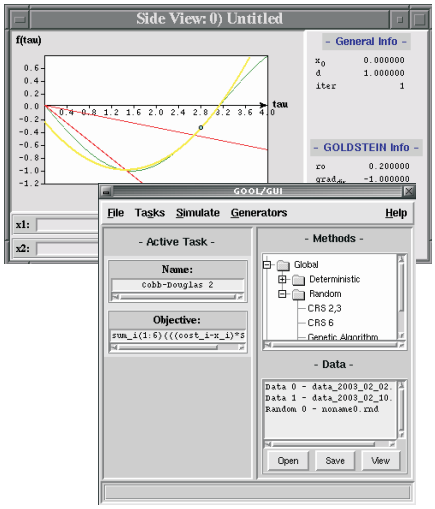
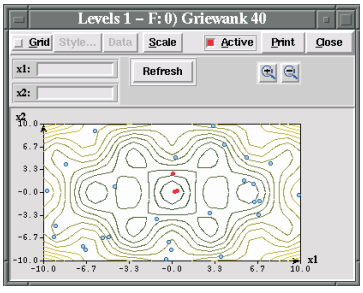
### Global optimization

**GOOL - Global Optimization Object–Oriented Library**




**GOOL**

library of random search generators and optimization algorithms for convex and nonconvex, unconstrained and constrained problems

## Complex Systems Group

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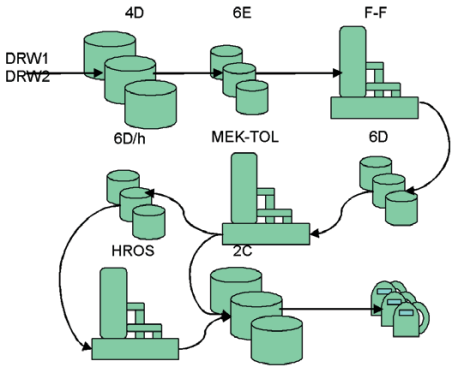
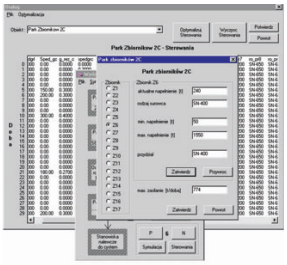
# Operations scheduling using Constraint Programming

### Solution of a scheduling problem in an Oil Refinery Division




Oil Refinery Division



Simulation and optimization system

Goals:
- Simulation of an Oil Refinery Division
- Finding all feasible solutions
- Meeting all technical requirements
- Constraint scheduling methods
- Very fast computations

## Complex Systems Group

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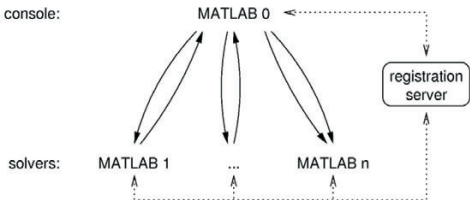
# Parallel and distributed computations

- research on price and Benders method of decomposed optimization
- research on parallel implementation of global optimization algorithms
- development of new software tools for parallel and distributed computations
- a monograph published in 2009





### New software tools:

- **jPar** – a software environment for parallelizing Matlab calculations on multicores and in clusters without file communication
- **parAMPL** – a library for parallelizing AMPL calculations on multicores and in clusters

## Complex Systems Group

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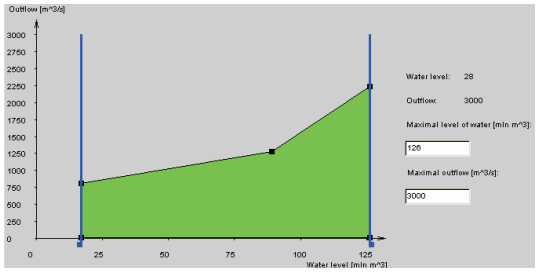
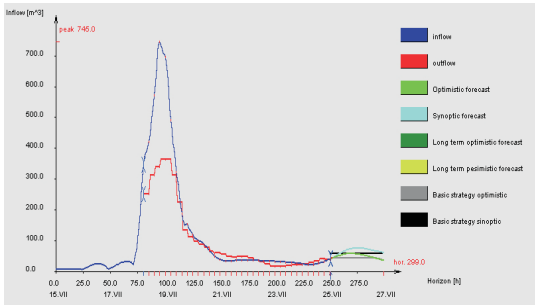
### Optimal control and closed-loop design

- development of OO libraries for calculation of optimal control in general nonlinear deterministic problems with constraints
- development of OO libraries for calculation of optimal closed-loop policies in general stochastic problems
- development of Decision Support Systems for flood control in single and multireservoir systems
- theoretical studies on optimal control in various conditions eg. with stochastic scenarios, fuzzy systems, worst-case, different risk measures, etc.
- theoretical and simulation studies on real-time control in computer networks at different levels




## Complex Systems Group

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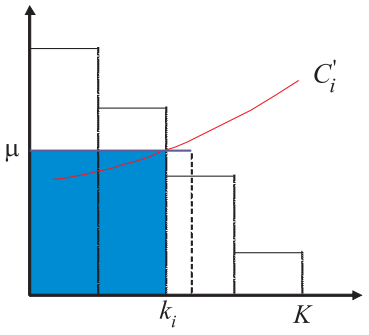
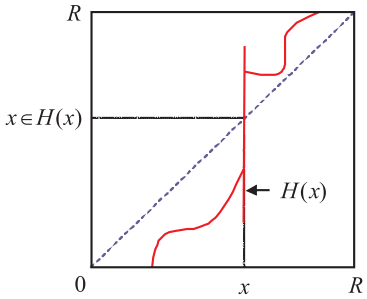
### Game theory and mechanism design

- auction and market design
- computation of equilibrium bidding strategies
- incentive regulation in telecommunication




- resource allocation under imperfect information
- principal-agent problems in optimal contract design
- best response dynamics and stability of Nash equilibria

## Complex Systems Group

Instytut Automatyki i Informatyki Stosowanej

# Interval computations for nonlinear problems

Instead of single numbers (points), we can perform calculations on intervals (possibly multidimensional).

Rules of interval arithmetic (and other interval functions) are designed so that:

$$a \in \boldsymbol{a} = [\underline{a}, \overline{a}],\ b \in \boldsymbol{b} = [\underline{b}, \overline{b}],$$
$$\circ \in \{+, -, \cdot, /\} \Rightarrow a \circ b \in \boldsymbol{a} \circ \boldsymbol{b}$$

Such an approach allows to describe the uncertainty of parameters and also to deal with numerical inacuracy.

For example we have the following rules for addition and multiplication:

$$[\underline{a}, \overline{a}] + [\underline{b}, \overline{b}] = [\underline{a} + \underline{b}, \overline{a} + \overline{b}]$$
$$[\underline{a}, \overline{a}] \cdot [\underline{b}, \overline{b}] = [\min\{\underline{a}\underline{b}, \underline{a}\overline{b}, \overline{a}\underline{b}, \overline{a}\overline{b}\}, \max\{\underline{a}\underline{b}, \underline{a}\overline{b}, \overline{a}\underline{b}, \overline{a}\overline{b}\}]$$

Interval (inclusion) function:

$$f(x) = x^2 + 2x + 1$$
$$\mathbf{f}(\boldsymbol{x}) = \boldsymbol{x}^2 + 2\boldsymbol{x} + 1$$
$$x \in \boldsymbol{x} = [\underline{x}, \overline{x}] \Rightarrow f(x) \in \mathbf{f}(\boldsymbol{x})$$
$$\mathbf{f}([-5, 1]) = [-5, 1]^2 + 2 \cdot [-5, 1] + 1 = [-9, 28] \supseteq [0, 16]$$

Interval tools:

- the branch-and-bound method
- monotonicity test
- interval Newton operators
- constraint propagation
- ...

Problems that can be solved:

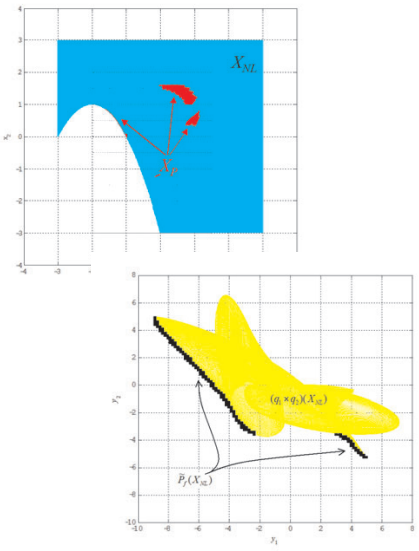
- systems of nonlinear equations
- constraint satisfaction problems
- global optimization problems
- multicriterial optimization problems (convex and nonconvex)

## Complex Systems Group

Instytut Automatyki i Informatyki Stosowanej

# Interval computations seek the Pareto-front of nonlinear multicriterial problems

```
compute (q(), x0, ey, ex)
// L is the list of quadruples
// (y, L_in, L_bound, L_unchecked),
// where L's are lists of qes x
y0 = q(x0);
enqueue(L, (y0, {}, {}, {x0}));
while (a quadruple in L,for which
        wid(y)>ey)
   pop this quadruple
        (y,L1,L2,L3) from L;
   if (L1?{}) then
      delete sets dominated by y;
   end if
   if (wid(y) > ey) then
        bisect y;
        invert resulting sets;
        enqueue results;
   end if
end while
end compute
```



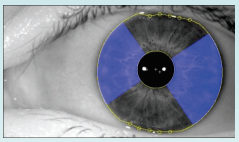
## Biometrics and Machine Learning Group

Instytut Automatyki i Informatyki Stosowanej

# Biometrics

### Iris recognition

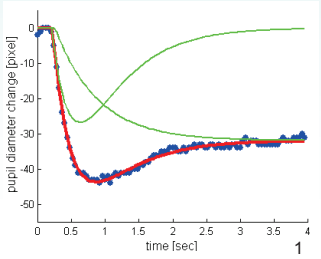
- Methods
  - fast Zak-Gabor transform for calculation of the unique iris features
  - active contours for flexible iris segmentation
  - randomization of the iris stripes for replay attack prevetion
- Liveness detection
  - use of static 2D and 3D images, frequency spectrum analysis, assessment of light 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




1

## Biometrics and Machine Learning Group

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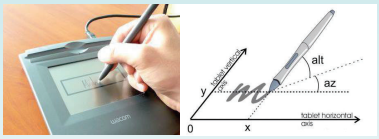
# Biometrics

### Handwritten signature-based identity verification

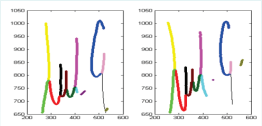
**Verification of dynamic signatures (on-line)**

- 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

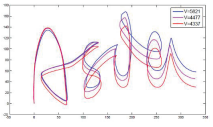


**Template creation improvements:**

- ***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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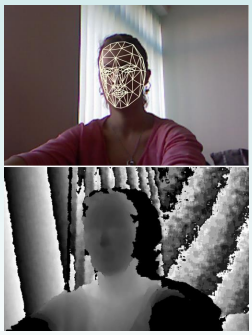
## Biometrics

### 2D and 3D processing techniques for face verification

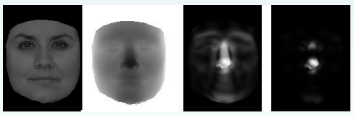
**Different methods of aquiring spatial face data**

- 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.

3

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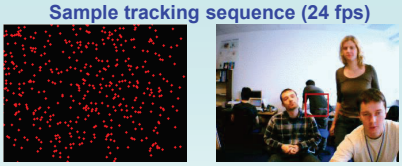
## Biometrics

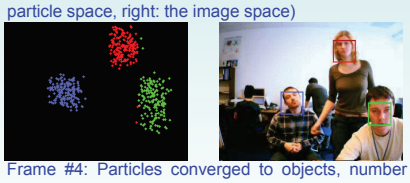
### Particle filter-based face tracking and identification

- 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

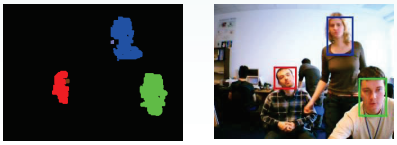
**Sample tracking sequence (24 fps)**



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

4

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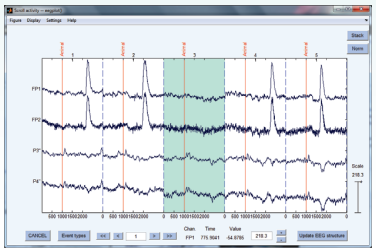
## Biometrics

### 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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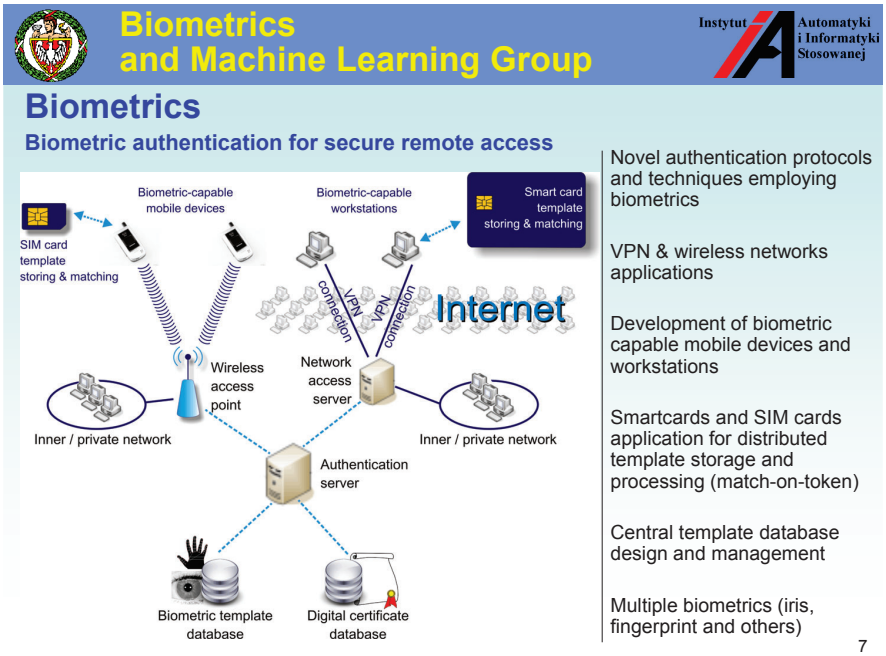
## Biometrics

### 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

6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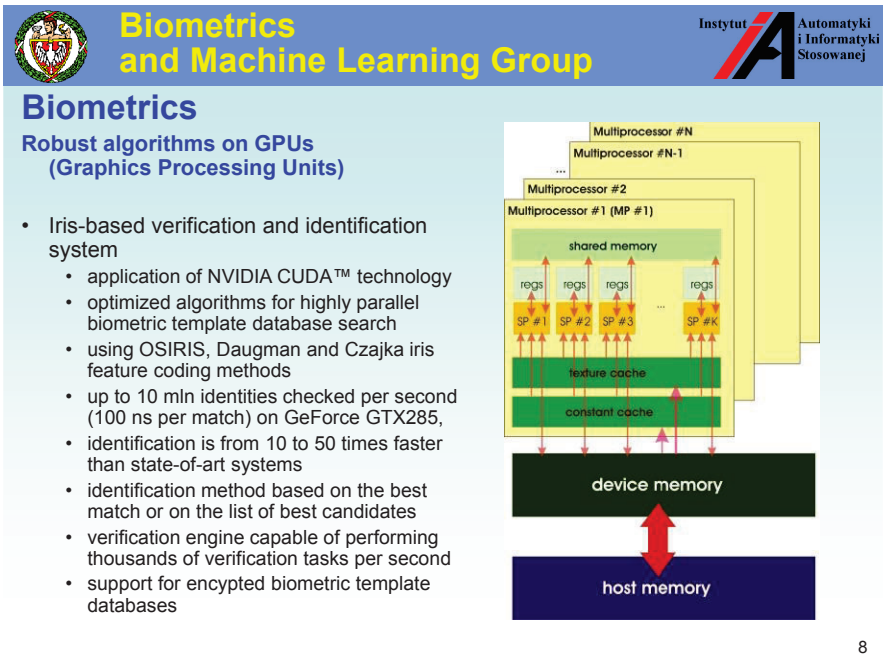
Biometrics
Biometric authentication for secure remote access
Biometric-capable mobile devices
Biometric-capable workstations
Smart card template storing & matching
SIM card template storing & matching
VPN connection
VPN connection
Internet
Wireless access point
Network access server
Inner / private network
Inner / private network
Authentication server
Biometric template database
Digital certificate database
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
Multiprocessor #N
Multiprocessor #N-1
Multiprocessor #2
Multiprocessor #1 (MP #1)
shared memory
regs
SP #1
SP #2
SP #3
SP #K
texture cache
constant cache
device memory
host memory
8

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## Secure biometric documents

**Biometrics and PKI techniques for modern identity documents and protection of information systems – BIOPKI (NCBiR grant No. OR0B002701)**

- Research areas
  - Public key infrastructure with „forgery evident" methodology
  - Techniques for restricted identification
  - Detection of data and document vulnerabilities
  - Application of biometrics for analogue and digital documents
  - Use of steganography for protection of data and devices
  - Renewable biometric references
- Consortium
  - Research and Academic Computer Network – coordinator
  - **Institute of Control and Computation Engineering, Warsaw University of Technology**
  - Wrocław Technical University
  - Trusted Information Consulting
  - Asseco Poland

BioPKI

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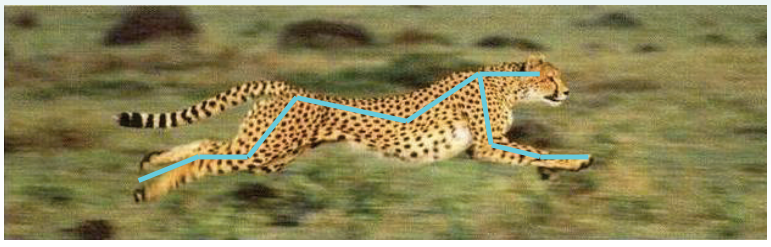
## Machine Learning

**Towards parameterless on-line learning algorithms**

Most on-line learning are based on stochastic steepest descent.
This methodology requires preliminary experiments to determine proper step-size.
We develop methods to automatize stochastic steepest descent.
We successfully tested several approaches using a simulated planar model of cheetah.



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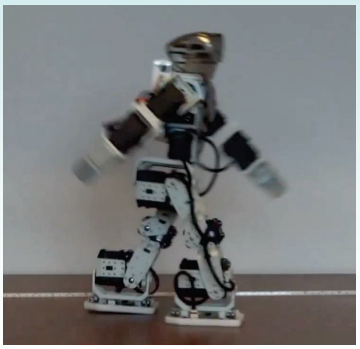
## Machine Learning

### Project on humanoid robots learning of physical activities

In cooperation with the Faculty of Mechatronics we run a project on learning in humanoid robots.

The immediate objective of the project is to design algorithms that enable the robots to learn to walk and adroitly run.



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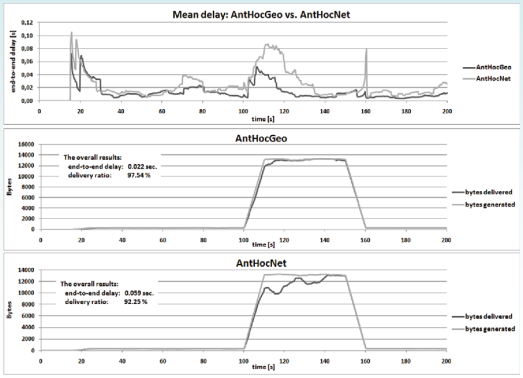
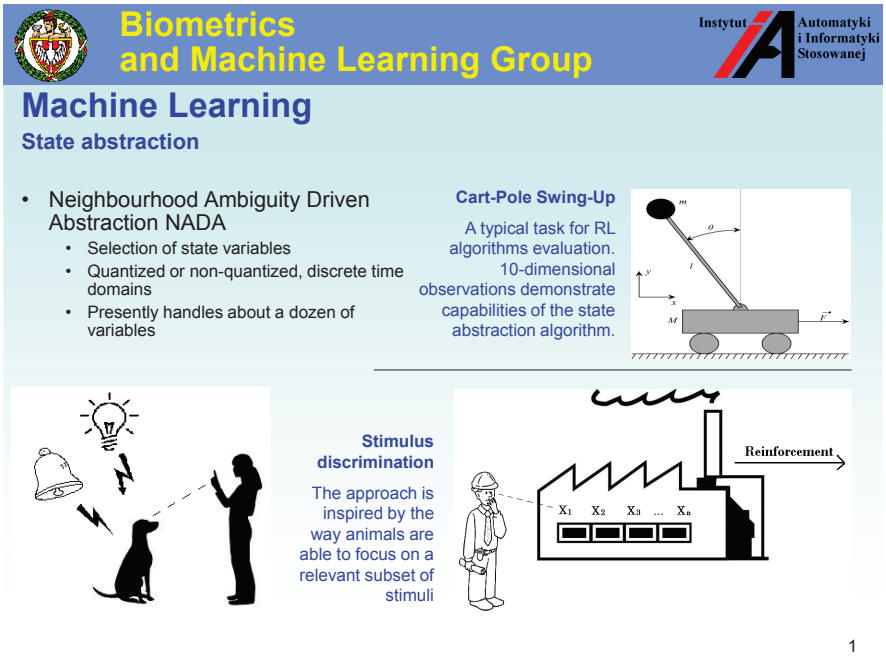
## Machine Learning

### Ant routing with distributed geographical localization of knowledge in ad-hoc networks

- Highly dynamic environment
- Information gathered by ant agents is labeled with locations within the network rather than with the nodes themselves
- The information is exchanged between the nodes as they move across the network
- Routing connections defined on the locations level are much more robust to dynamical topology changes than the connections on the nodes level
- The method improves both the adaptation capabilities and the overall network performance




12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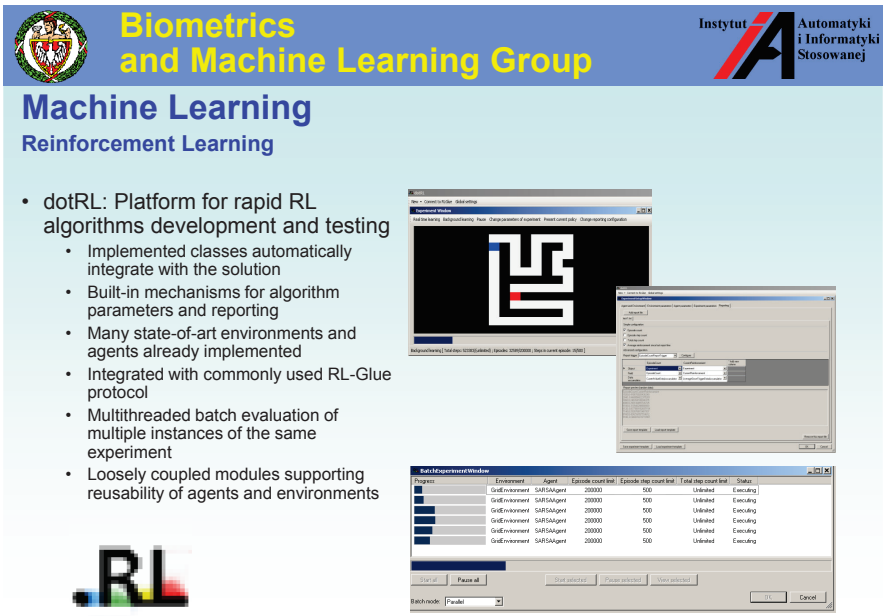
Machine Learning
State abstraction
• Neighbourhood Ambiguity Driven Abstraction NADA
• Selection of state variables
• Quantized or non-quantized, discrete time domains
• Presently handles about a dozen of variables
Cart-Pole Swing-Up
A typical task for RL algorithms evaluation. 10-dimensional observations demonstrate capabilities of the state abstraction algorithm.
Stimulus discrimination
The approach is inspired by the way animals are able to focus on a relevant subset of stimuli
Reinforcement
X1 X2 X3 ... Xn
1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Machine Learning
Reinforcement Learning
• dotRL: Platform for rapid RL algorithms development and testing
• Implemented classes automatically integrate with the solution
• Built-in mechanisms for algorithm parameters and reporting
• Many state-of-art environments and agents already implemented
• Integrated with commonly used RL-Glue protocol
• Multithreaded batch evaluation of multiple instances of the same experiment
• Loosely coupled modules supporting reusability of agents and environments
RL
2

## Robot Programming and Pattern Recognition Group

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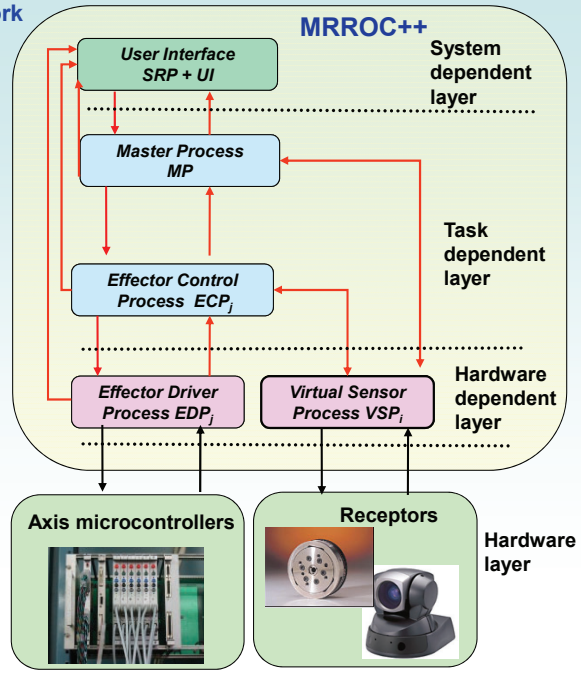
### MRROC++ robot programming framework

- 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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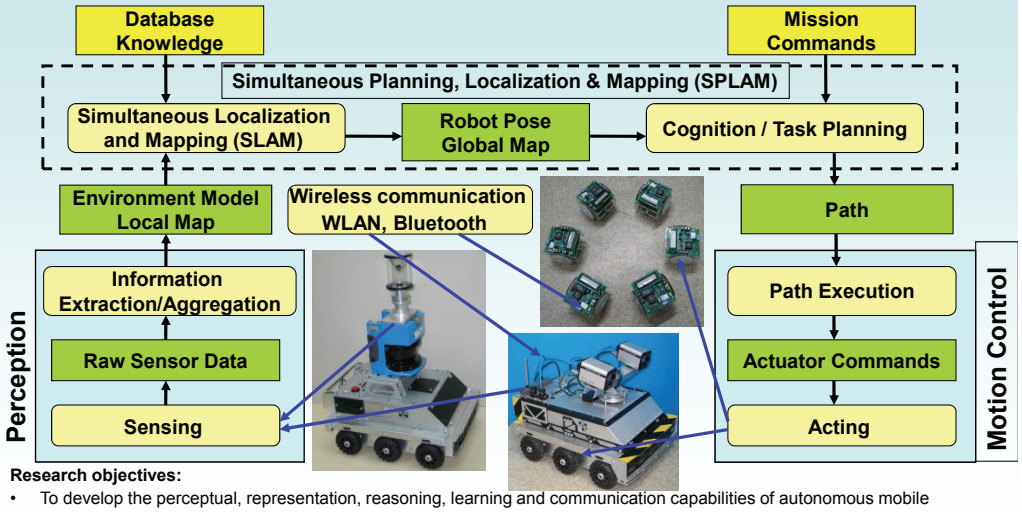
### Control architecture for autonomous mobile robot teams




**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)

## Robot Programming and Pattern Recognition Group

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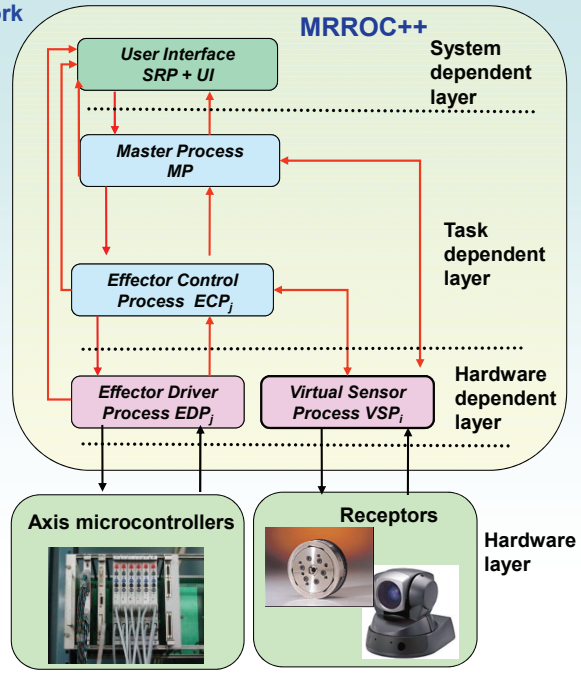


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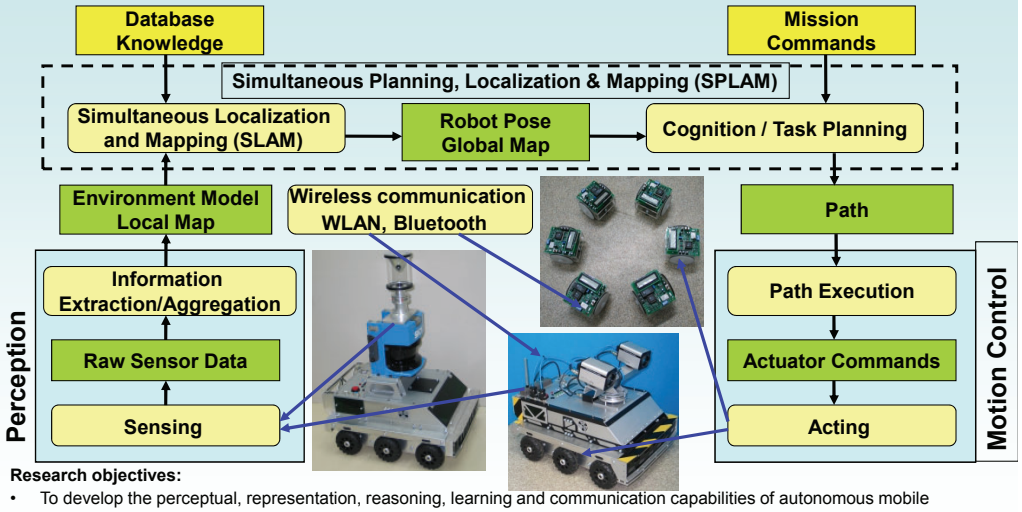
### Control architecture for autonomous mobile robot teams

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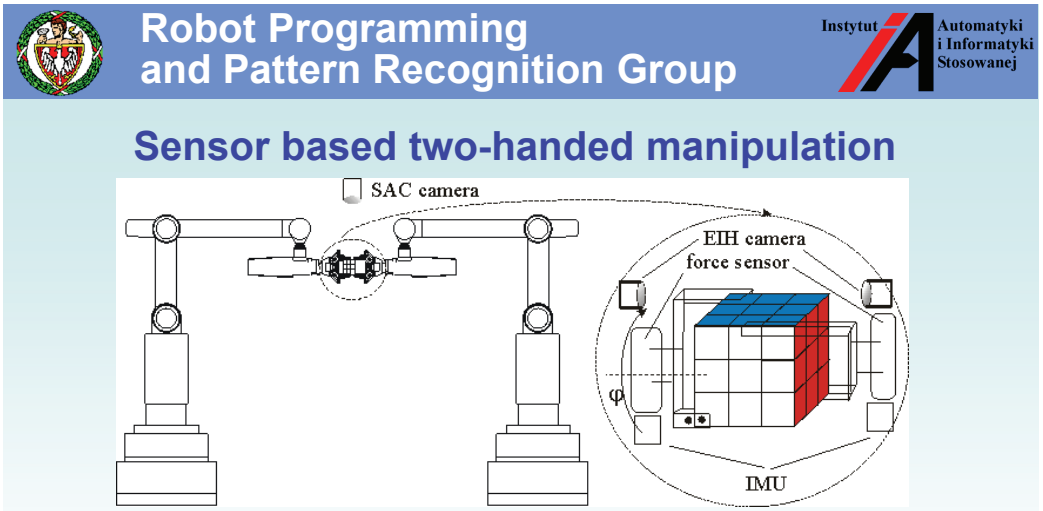
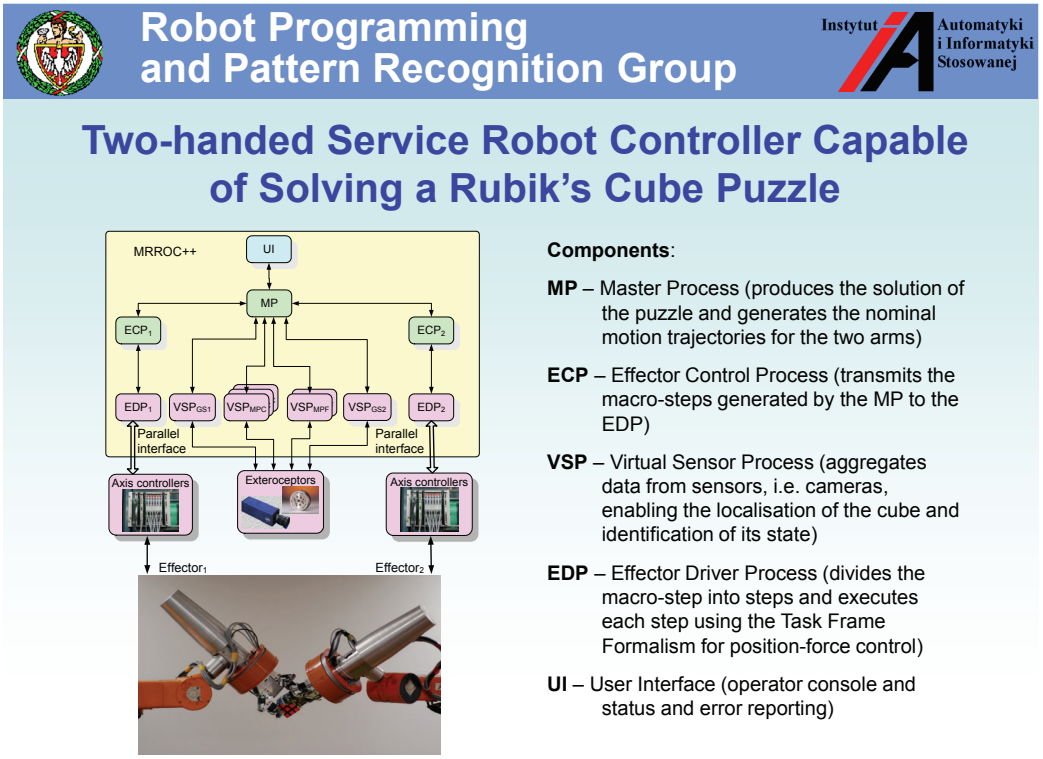



**Solution of the benchmark task requires:**

- **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**




**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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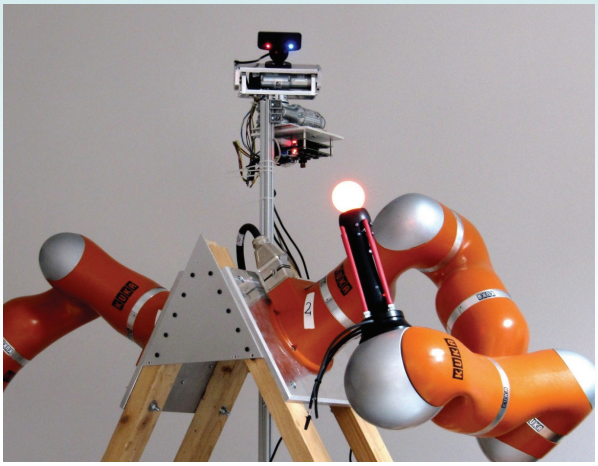
# Velma: two arm robotic system with redundant manipulators and active head



### 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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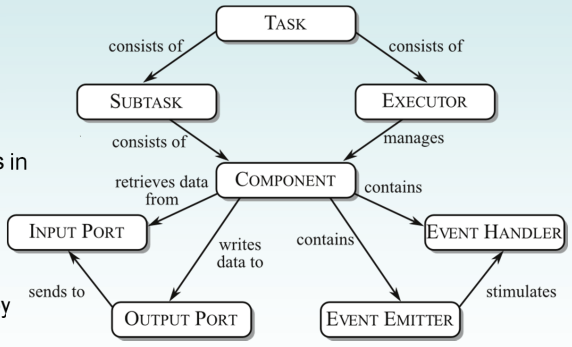
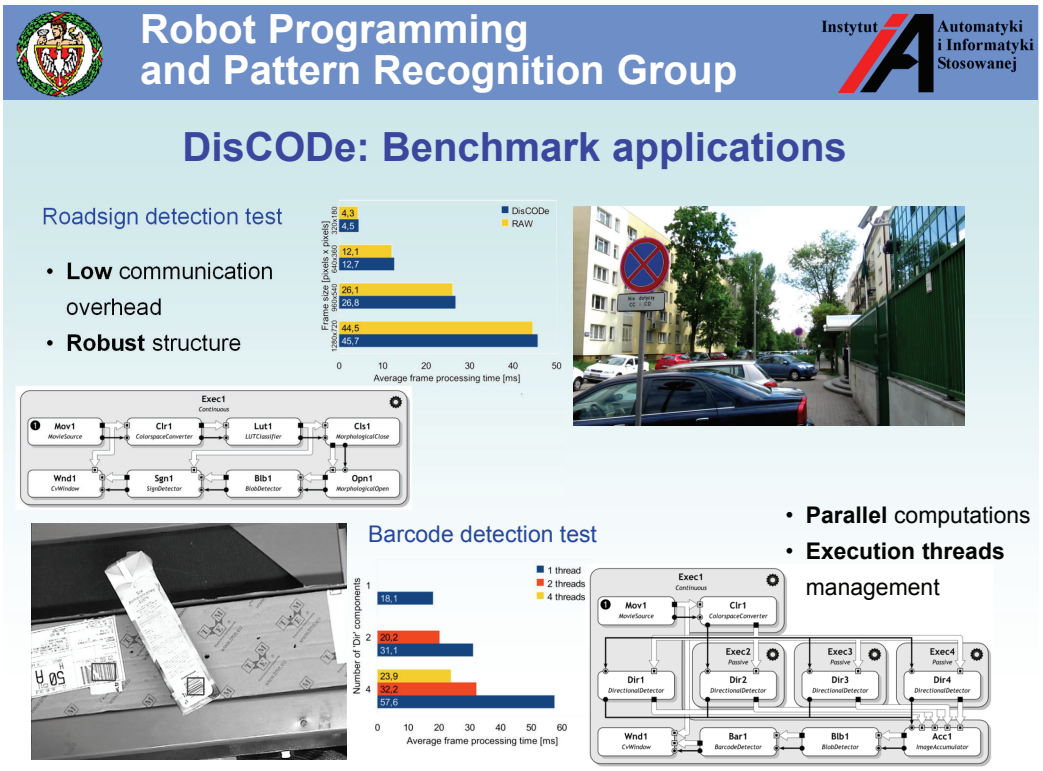
# DisCODe: Distributed Component Oriented Data Processing

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

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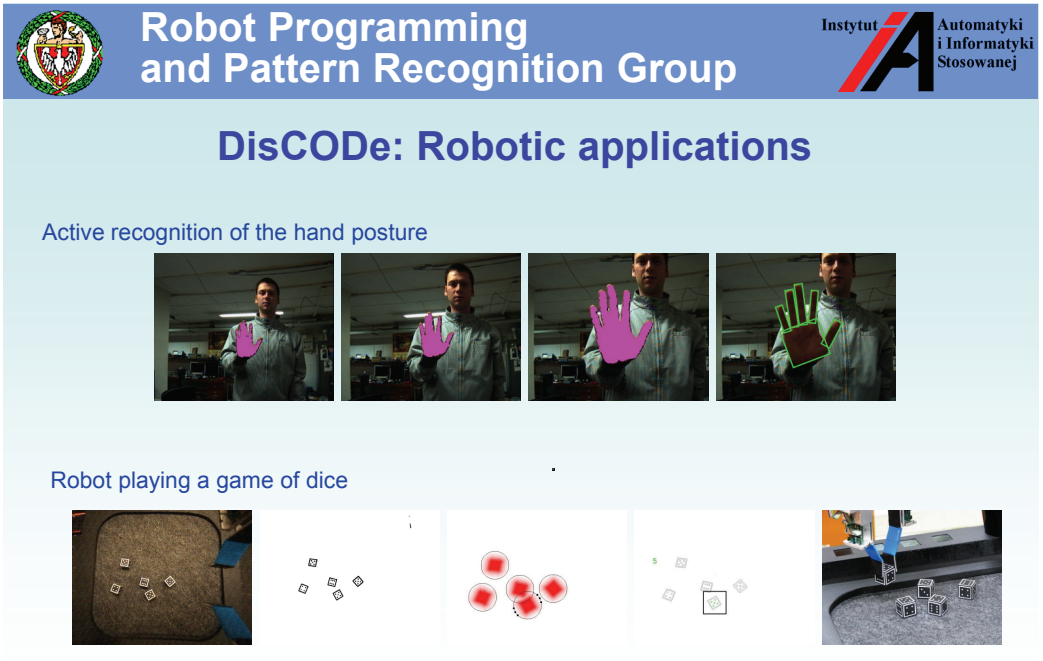
DisCODe: Benchmark applications
Roadsign detection test
• Low communication overhead
• Robust structure
DisCODe
RAW
Frame size [pixels x pixels]
320x180
640x360
960x540
1280x720
4,3
4,5
12,1
12,7
26,1
26,8
44,5
45,7
0 10 20 30 40 50
Average frame processing time [ms]
Exec1
Continuous
Mov1
MovieSource
Clr1
ColorspaceConverter
Lut1
LUTClassifier
Cls1
MorphologicalClose
Wnd1
CvWindow
Sgn1
SignDetector
Blb1
BlobDetector
Opn1
MorphologicalOpen
Barcode detection test
• Parallel computations
• Execution threads management
1 thread
2 threads
4 threads
Number of Dir components
1
2
4
18,1
20,2
31,1
23,9
32,2
57,6
0 10 20 30 40 50 60
Average frame processing time [ms]
Exec1
Continuous
Mov1
MovieSource
Clr1
ColorspaceConverter
Exec2
Passive
Exec3
Passive
Exec4
Passive
Dir1
DirectionalDetector
Dir2
DirectionalDetector
Dir3
DirectionalDetector
Dir4
DirectionalDetector
Wnd1
CvWindow
Bar1
BarcodeDetector
Blb1
BlobDetector
Acc1
ImageAccumulator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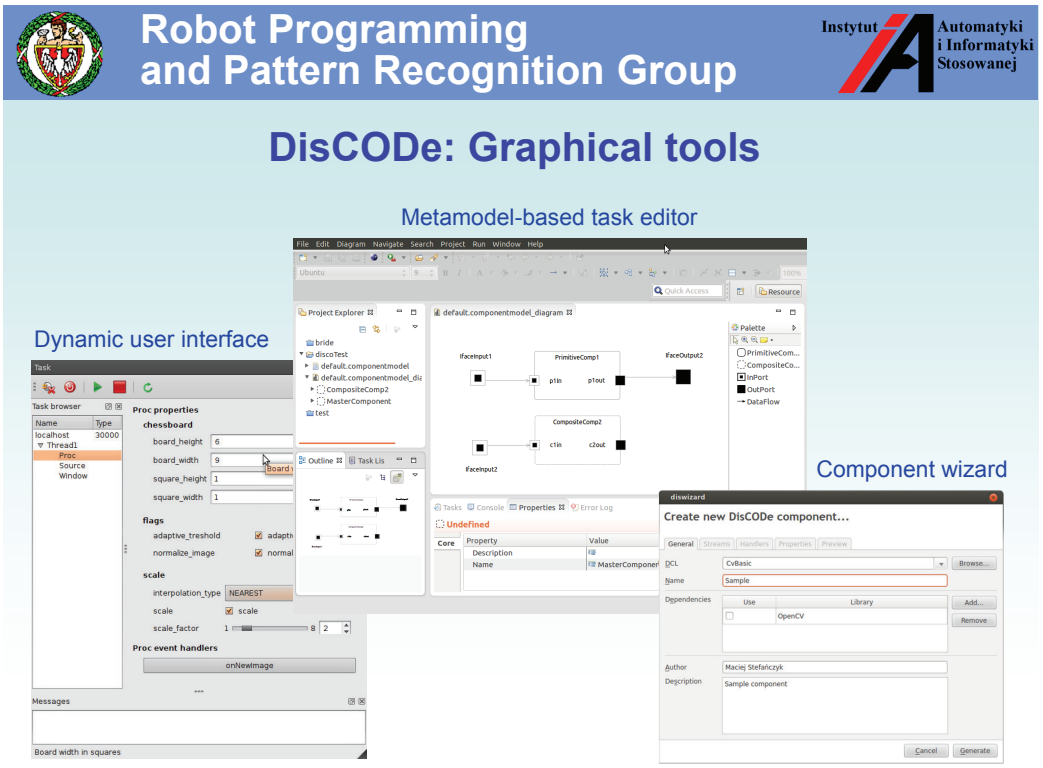
DisCODe: Robotic applications
Active recognition of the hand posture
Robot playing a game of dice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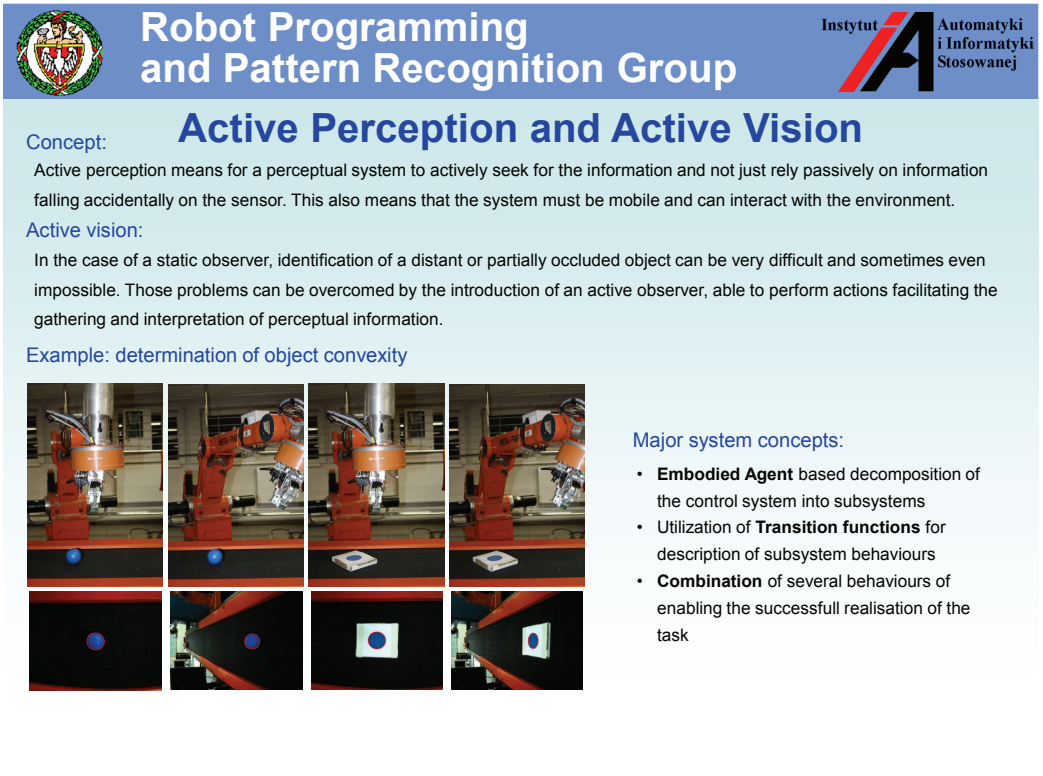
DisCODe: Graphical tools
Metamodel-based task editor
Dynamic user interface
Component wizard
Create new DisCODe component...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Active Perception and Active Vision
Concept:
Active perception means for a perceptual system to actively seek for the information 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

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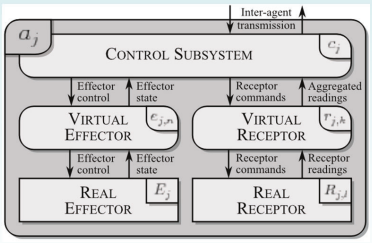
## Embodied Agent: a robot control system design method

### 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**.

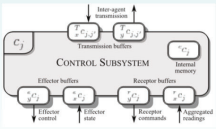
### Embodied Agent:



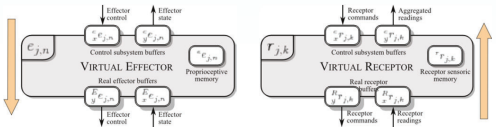

- **Embodied Agent** - any device or program having the ability to perceive its surroundings to subsequently influence the environment state, can communicate with other agents and has an internal imperative to achieve its goal.

### 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.




11

Robot Programming and Pattern Recognition Group

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## Elementary behaviours of robot manipulators

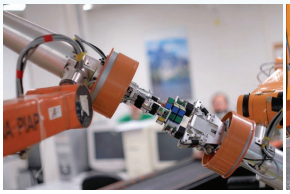
### Main concepts:

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

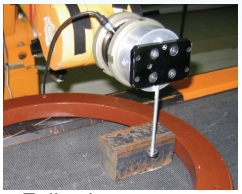
- unconstrained motion with the assumption that no contact with obstacles will be encountered – where pure position control suffices
- contact with the environment – where pure force control is used,
- intermediate or transitional behavior – where initially unconstrained motion is expect to result in 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.

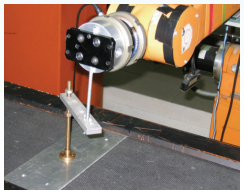
**In terms of those behaviors complex tasks can be specified formally and implemented.**



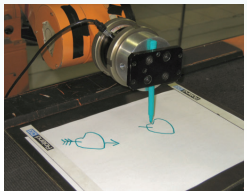
Rubik's cube solver



Following an unknown contour



Rotating a crank



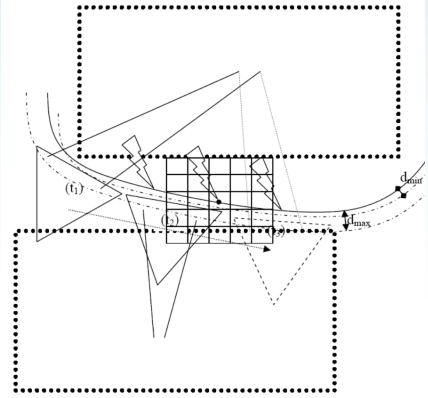
Copying drawings

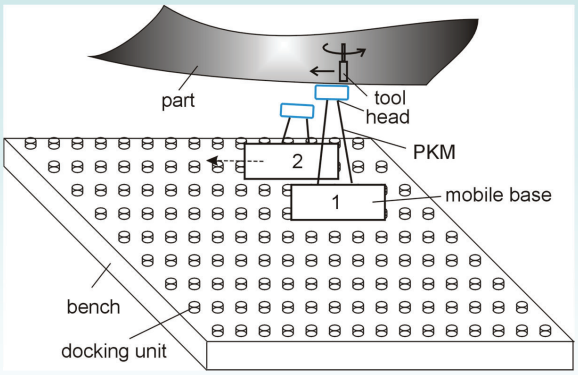
## Robot Programming and Pattern Recognition Group

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.

## Robot Programming and Pattern Recognition Group

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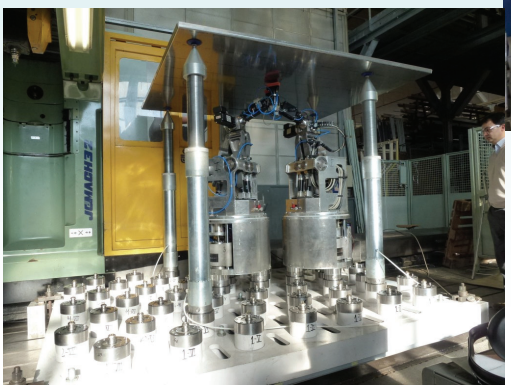
# Mobile supports replacing static fixtures

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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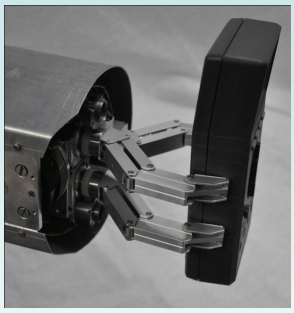
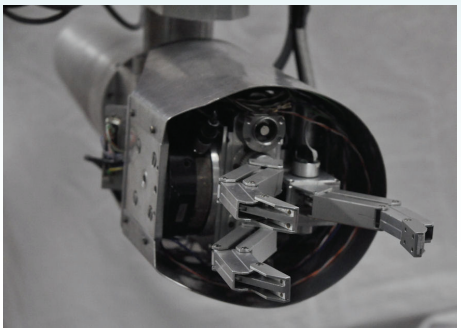
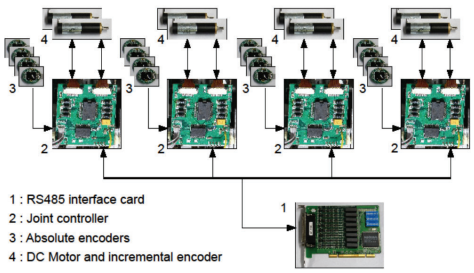
### Three finger gripper

- 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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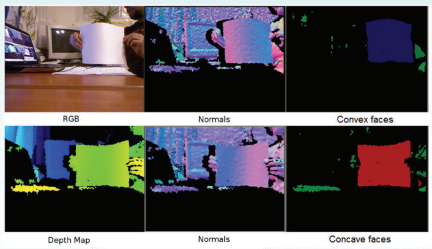
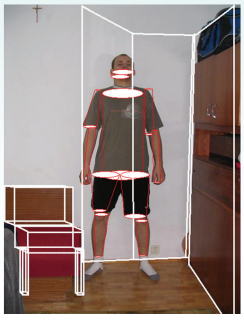
### Computer Vision in mobile and service robotics

Environment map generation, obstacle avoidance.

Depth-map and color image Segmentation



3D object recognition

## Robot Programming and Pattern Recognition Group

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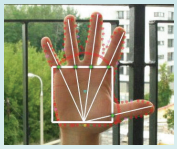
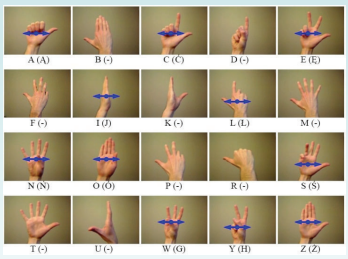
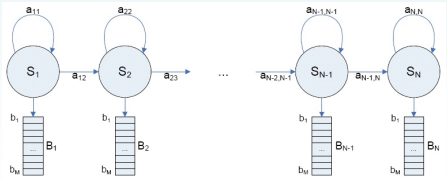
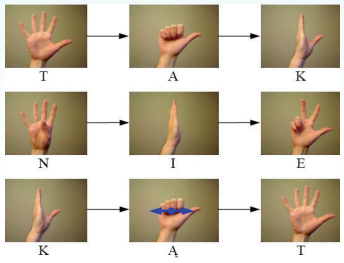
### Palm pose and gesture recognition in video sequences



- Palm pose recognition
- Static and dynamic („letters”):
- HMM and DBN modelling of pose sequences:




- Examples of gestures („words”):

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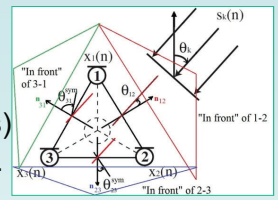
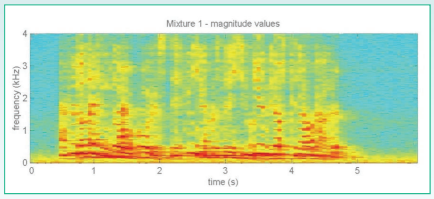
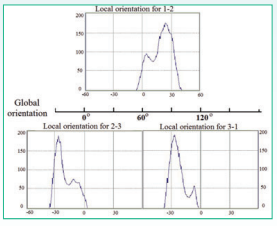
### Auditory scene analysis



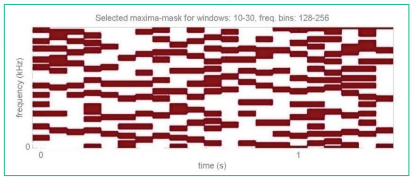

- Only mixtures of source signals can be acquired,
- The goal is to estimate the directions (and locations) of the speakers and to estimate the original sources.




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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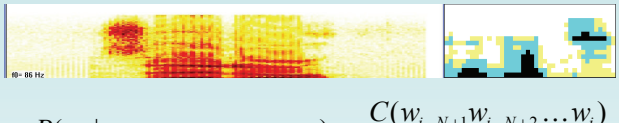
### Spoken sentence recognition

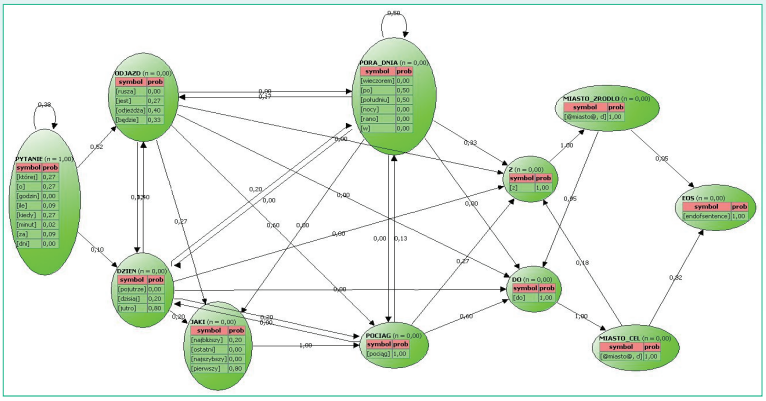
- Spectral analysis
- Acoustic-phonetic features
- Word recognition
- A N-gram language model

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

- HMM-based sentence recognition



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

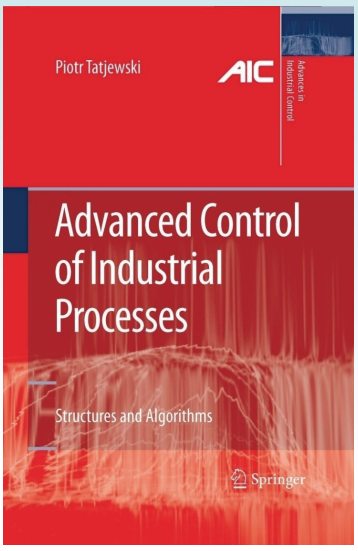


## Control Engineering Group

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

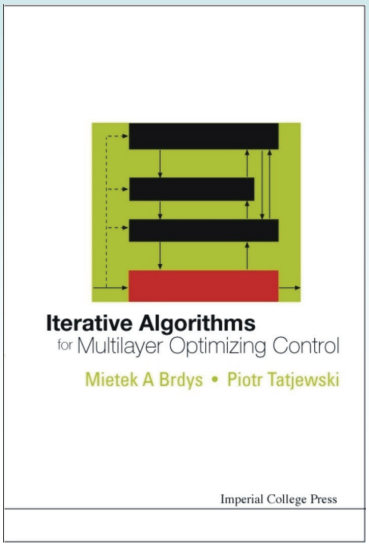


## Control Engineering Group

Instytut Automatyki i Informatyki Stosowanej

### 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

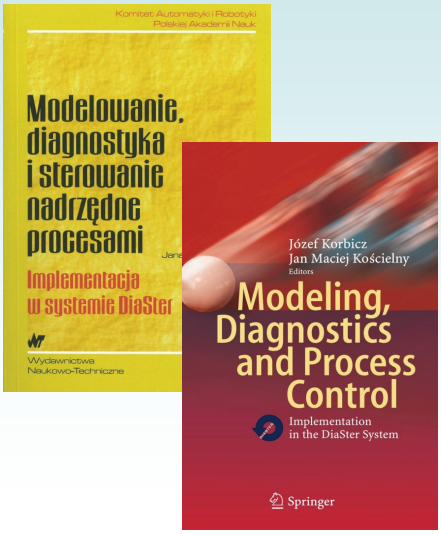



## Control Engineering Group

Instytut Automatyki i Informatyki Stosowanej

### 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



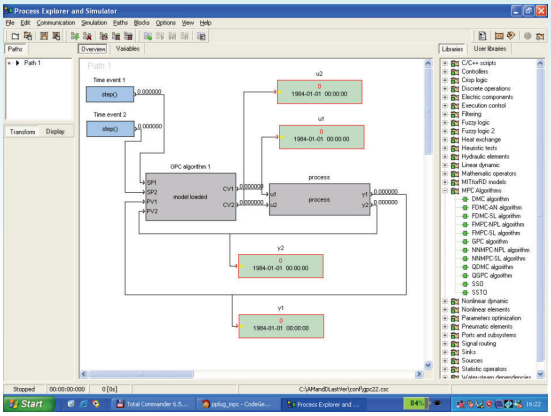
## Control Engineering Group

Instytut Automatyki i Informatyki Stosowanej

### 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

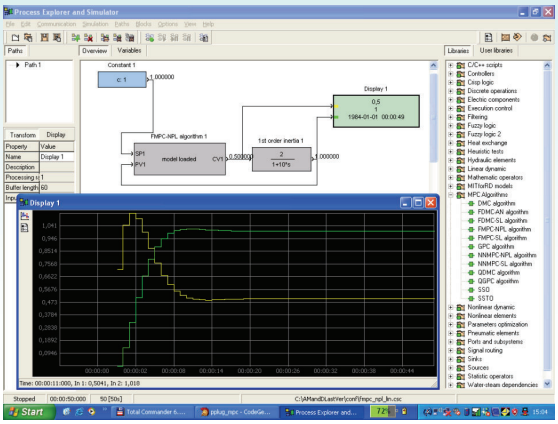
## Control Engineering Group

Instytut Automatyki i Informatyki Stosowanej

### 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

## Control Engineering Group

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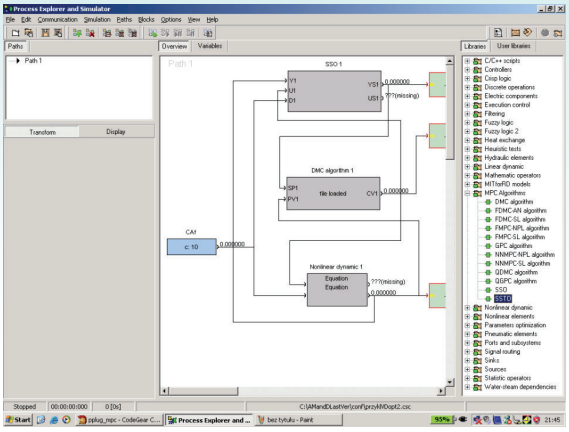
### DiaSter (Diagnostic and Control) software system

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

## Control Engineering Group

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### 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)

## Control Engineering Group

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### The anti-smoke ventilation control in 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)

## Control Engineering Group

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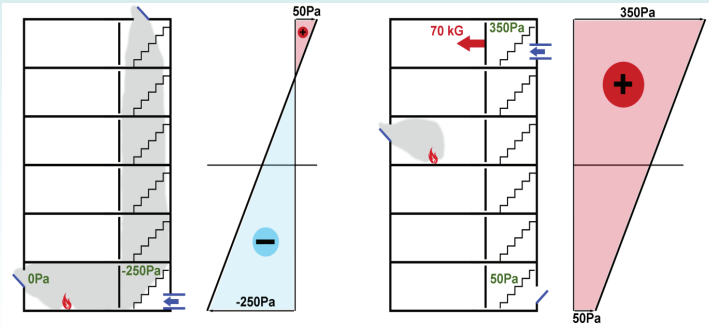
### The anti-smoke ventilation control in high buildings

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 manufactured by ***Plum*** company)

## Software Engineering Group

Instytut Automatyki i Informatyki Stosowanej

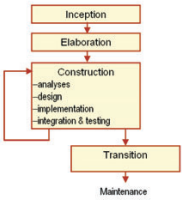
# Software development

**Research topics:**

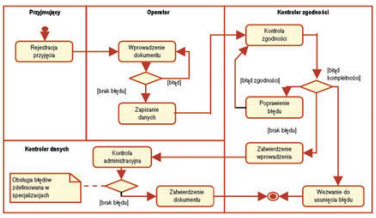
- Business process modeling
- Requirements engineering
- Software development methods
- Technologies and tools
- Acceptance testing
- Software processes
- Project management

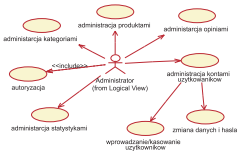
***Systems and tools* :**

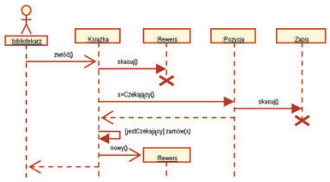
- Rational Rose
- Rational RequisitePro
- Structured Architect











## Software Engineering Group

Instytut Automatyki i Informatyki Stosowanej

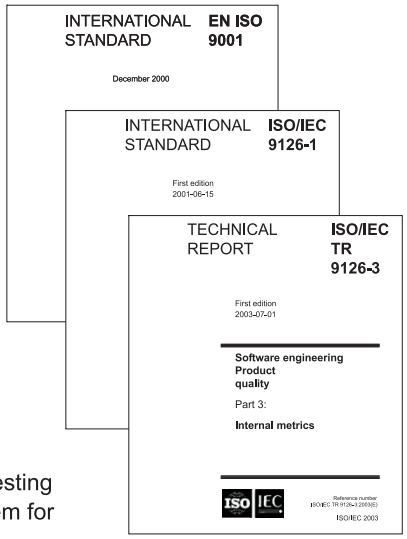
# Evaluation of the software quality

**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

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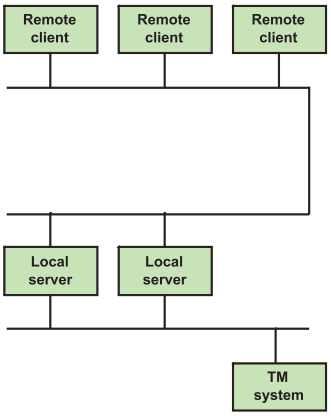
### Distributed Open Systems

**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

## Operations Research and Management Systems Group

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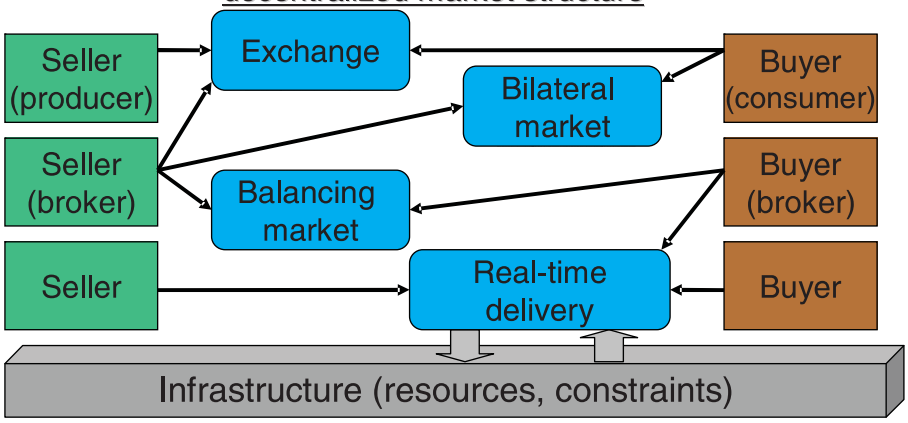
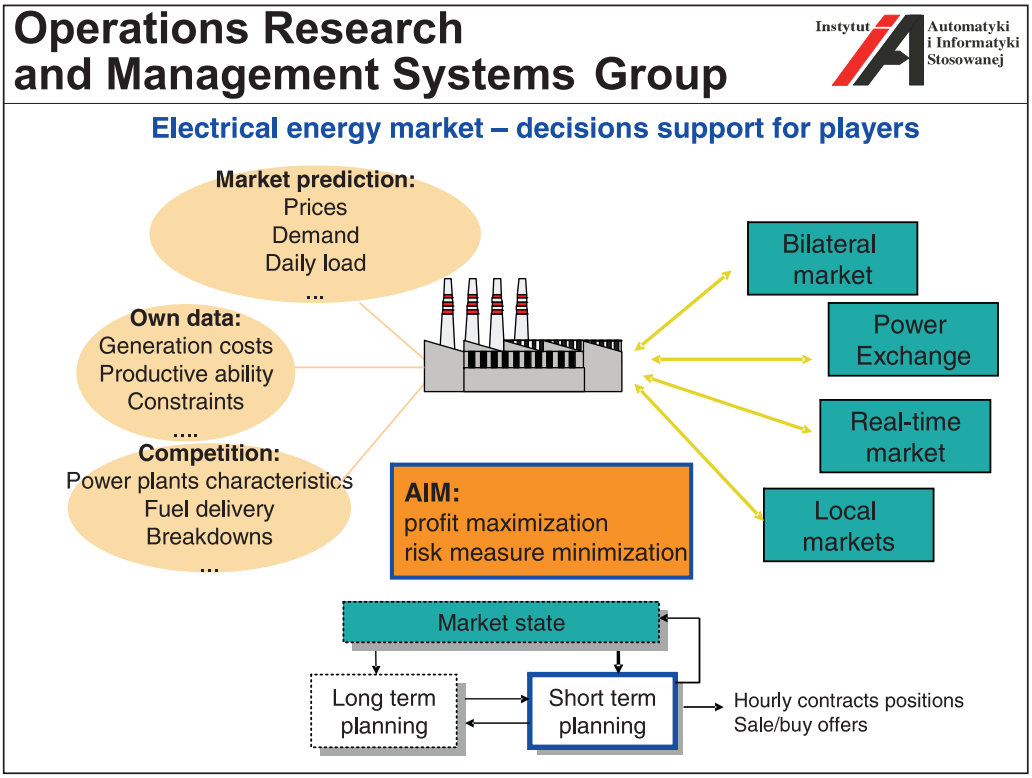
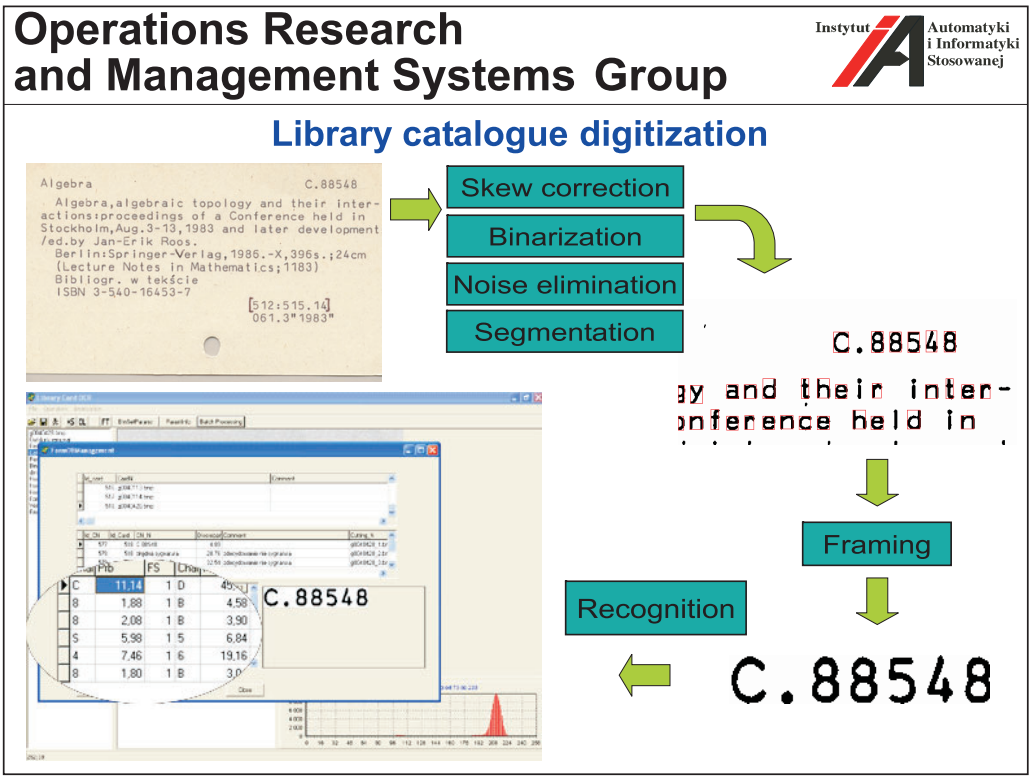
### Designing of infrastructure markets under constraints

decentralized market structure




- 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


Operations Research
and Management 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


Operations Research
and Management Systems Group
Instytut Automatyki i Informatyki Stosowanej
Library catalogue digitization
Skew correction
Binarization
Noise elimination
Segmentation
C.88548
Framing
Recognition
C.88548

# Operations Research and Management Systems Group

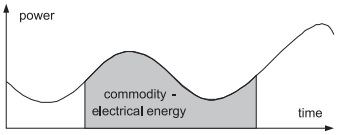
Instytut Automatyki i Informatyki Stosowanej

## $M^3$ Multicommodity Market Model

**$M^3$ is a flexible and universal market data and communication model**
**http://www.openm3.org**

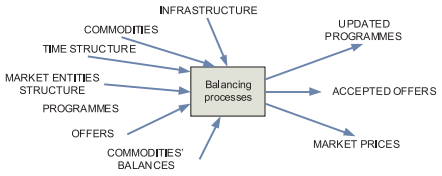
**$M^3$** is mainly (but not only) designed for

- **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




**$M^3$** 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 $M^3$** describes the inputs and outputs of elementary balancing process:




**$M^3$** helps markets' development by providing

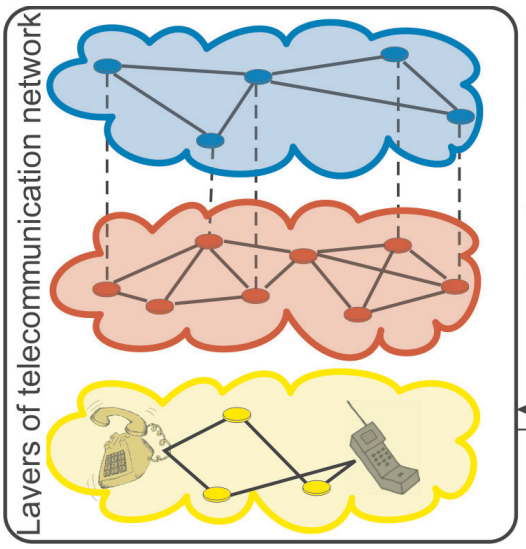
- flexible framework both for real-world market systems and for research projects
- possibilities for integration of software components
- possibilities for organizing benchmark data repository

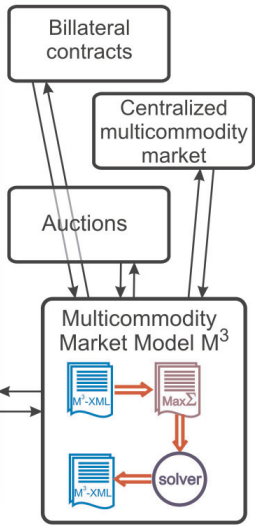
# Operations Research and Management Systems Group

Instytut Automatyki i Informatyki Stosowanej

## Design of Multicommodity Market Model – $M^3$

## Application of $M^3$ on the Communication Bandwidth Market




**$M^3$ 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

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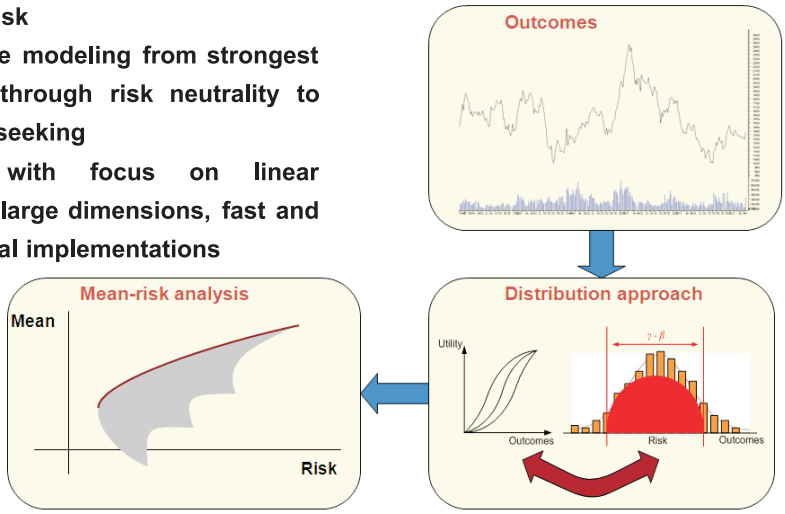
### Risk Measures and Optimization under Risk

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

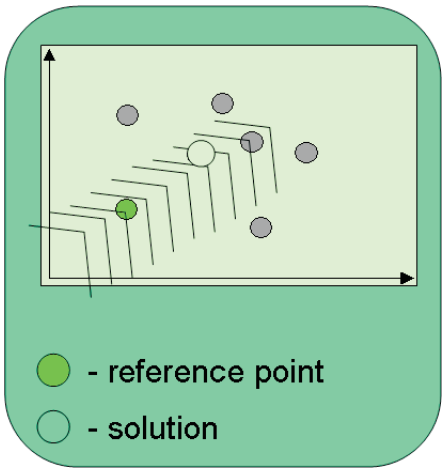



## Optimization and Decision Support Group

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

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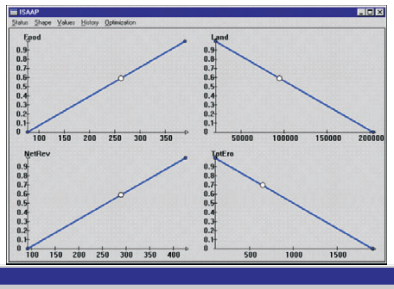
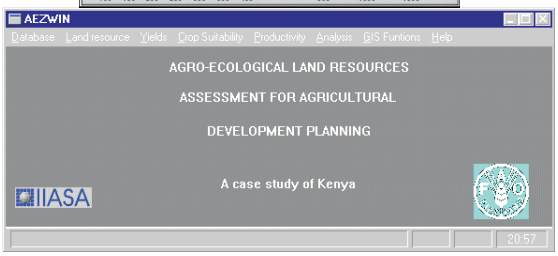
### Application of the reference point method for land resource assessment



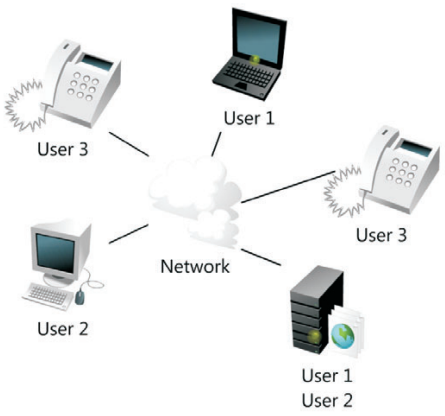



## Optimization and Decision Support Group

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 | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|
| | persons | FTE | persons | FTE | persons | FTE |
| **Academic Staff** | 46(+1) | 39.7(+0.5) | 47 | 40 | 44 | 38.5 |
| by titles/degrees | | | | | | |
| Professors | 6 | 6 | 7 | 7 | 7 | 7 |
| D.Sc.-s | 4 | 4 | 4 | 4 | 6 | 6 |
| Ph.D.-s | 27(+1) | 24(+0.5) | 29 | 25 | 28 | 23.5 |
| M.Sc.-s | 9 | 5.7 | 7 | 4 | 3 | 2 |
| by positions | | | | | | |
| Professors | 9 | 9 | 9 | 9 | 9 | 9 |
| Readers | 2 | 2 | 2 | 2 | 1 | 1 |
| Assistant Professors | 25(+1) | 22.5(+0.5) | 28 | 24.5 | 30 | 26 |
| Senior Lecturers | 5 | 3.25 | 5 | 3 | 4 | 2.5 |
| Lecturers | 0 | 0 | 0 | 0 | 0 | 0 |
| Assistants | 5 | 2.95 | 3 | 1.5 | 0 | 0 |
| **Ph.D. Students** | 19 | | 19 | | 28 | |
| **Technical Staff** | 8 | 4.4 | 8 | 4.6 | 5 | 3.25 |
| **Administrative Staff** | 10 | 8.5 | 9 | 8 | 7 | 7 |

$FTE$ – Full Time Employment units,
$+$ – corrections due to persons on long-term leave of absence

| ACTIVITIES | 2011 | 2012 | 2013 |
|---|---|---|---|
| **Teaching activities** | | | |
| standard teaching potential, hours | 8 508.95 | 9 453.15 | 9 242.40 |
| # hours taught | 12 376.60 | 11 906.29 | 12 415.10 |
| **Degrees awarded** | | | |
| Professor | 2 | 1 | 0 |
| D.Sc | 1 | 1 | 2 |
| Ph.D. | 3 | 4 | 4 |
| M.Sc. | 50 | 52 | 46 |
| B.Sc. | 70 | 76 | 57 |
| **Research projects** | | | |
| granted by WUT | 3 | 6 | 4 |
| granted by State institutions | 15 | 12 | 13 |
| granted by international institutions | 5 | 3 | 4 |
| other | 6 | 8 | 6 |
| **Sci.-Tech. publications** | | | |
| monographs (authored or edited) | 2 | 4 | 4 |
| chapters in books and proceedings | 42 | 57 | 39 |
| papers in journals | 64 | 50 | 36 |
| **Reports, abstracts and other papers** | 12 | 24 | 42 |
| **Conferences** | | | |
| participation (# of conferences) | 43 | 66 | 34 |
| participation (# of part. from ICCE) | 70 | 84 | 41 |

| RESOURCES | 2010 | 2011 | 2012 |
|---|---|---|---|
| **Space (sq.m.)** | | | |
| laboratories | 585 | 585 | 585 |
| library + seminar room | 74 | 74 | 74 |
| faculty offices | 724 | 724 | 724 |
| **Computers** | | | |
| personal computers | 274 | 226 | 172 |
| **Library resources** | | | |
| books | 4 105 | 3 036 | 3 127 |
| booklets | 2 289 | 2 444 | 2 544 |
| 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, 2013.

## 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).

**Radosław Ładziński** Professor (retired January 1998)

**Systems Control Division, Complex Systems Group**
R.Ladzinski@ia.pw.edu.pl

*Born 1927, 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**
**room 523, tel. 22 234 7791**
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**
**room 530, tel. 22 234 7922**
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**
**room 523, tel. 22 234 7791**
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.

**Adam Czajka** Assistant Professor (part-time)

**Systems Control Division, Biometrics and Machine Learning Group**
**room 558, tel. 22 234 7805**
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 honors). Since 2003 he is with Warsaw University of Technology, and since 2002 with Research and Academic Computer Network (NASK). Chair of the Biometrics and Machine Learning Laboratory at ICCE. Head of the Postgraduate Studies on Security and Biometrics (2011–). V-ce Chair of the NASK Biometrics Laboratory and a member of the NASK Research Council (2006-). Member of the Technical Committee on Biometrics (2009–) and the Technical Committee No. 182 on Information Security in IT Systems (2007–) of Polish Normalization Committee (PKN), expert of the ISO/IEC SC37 on Biometrics. 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:* Interest: Biometrics (methods, devices and applications, security of biometrics, quality of biometric data, biometric standardization), pattern recognition.

**Paweł Domański** Assistant Professor

**Control and Software Engineering Division, Control Engineering Group**
**room 553, tel. 22 234 7121**
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 23, tel. 22 234 6191**
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 from WUT. D.Sc. 2012*

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.

**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.*

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

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

**Kamil Kołtyś** Assistant Professor (part-time)

**Operations and Systems Research Division.**
**Operations Research and Management Systems Group**
**room 526, tel. 22 234 7125**
K.J.Koltys@elka.pw.edu.pl

*M.Sc. 2007, Ph.D. 2012 from WUT*

With WUT since 2011.

*Interests:* Operations research, bandwidth auctions, mechanism design, multicommodity trade.

**Tomasz Kornuta** Assistant (part-time, until Oct. 2013), Assistant Proffesor (since Oct. 2013)

**Systems Control Division, Robot Programming and Pattern Recognition Group**
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**room 556, 22 234 7649**
T.Kornuta@elka.pw.edu.pl, http://tkornuta.googlepages.com

*M.Sc. 2005 from WUT.*

With WUT since 2008.

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

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

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**room 573a, tel. 22 234 7860**
akozakie@ia.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

**Operations and Systems Research Division, Optimization and Decision Support Group**
**room 25, tel. 22 234 7297**
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.

**Urszula Kręglewska** Senior Lecturer (part-time)

**Control and Software Engineering Division, Control Engineering Group**
**room 553, tel. 22 234 7121**
U.Kreglewska@ia.pw.edu.pl, www.ia.pw.edu.pl/~ukreglew

*M.Sc. 1973 from WUT.*

With WUT in 1973–1993 and from 1994 to present, with Digital Equipment Poland 1993–1994.

*Interests:* Computer interfaces design.

**Tomasz J. 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 25A, 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.

**Bartłomiej Kubica** Assistant Professor

**Systems Control Division, Complex Systems Group**
**room 573a, tel. 22 234 7860**
bkubica@elka.pw.edu.pl

*M.Sc. 2001, Ph.D. 2006 from WUT.*

With WUT since 2005.

*Interests:* Interval mathematics, optimization, numerical computations, parallel computing, multithreaded programming, real-time systems.

**Maciej Ławryńczuk** Assistant Professor

**Control and Software Engineering Division, Control Engineering Group**
**room 567, tel. 22 234 7673**
M.Lawrynczuk@ia.pw.edu.pl

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

With WUT since 2003. Winner of "Gold chalk" ("Złota kreda") award.

*Interests:* Process control and optimization, predictive control, neural networks, modelling.

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

**Systems Control Division, Complex Systems Group**
**room 517, tel. 22 234 7397 and 22 825 0995**
K.Malinowski@ia.pw.edu.pl, www.ia.pw.edu.pl/~malinows

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

With WUT since 1971. Director of ICCE (1984–1996), Dean of the FEIT (1996–1999). Member of the Senate of the Warsaw University of Technology (1993–2002), Chairman of the Senate Committee on Academic Staff (1993–1996 and 1999–2002), Chairman of Senate Committee on Research (1996–1999). Corresponding Member of the Polish Academy of Sciences (PAN) (since 1998), Member of the Warsaw Scientific Society (TNW), Chairman of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN), Professor in the Research and Academic Computer Network Institute (NASK), Vice-Chairman of the Scientific Council of NASK (2011–), Chairman of Task Group of Ministry of Science and Higher Education for assessment of applications for funding large scale research equipment and constructions (2011–), 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.

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

**Piotr Marusak** Assistant Professor

**Control and Software Engineering Division, Control Engineering Group**
**room 567, tel. 22 234 7673**
P.Marusak@ia.pw.edu.pl, www.ia.pw.edu.pl/~pmarusak

*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.

**Ewa Niewiadomska-Szynkiewicz** Professor (Leader of the Group)

**Systems Control Division, Complex Systems Group**
**room 572a, tel. 22 234 3650**
E.Niewiadomska@ia.pw.edu.pl, www.ia.pw.edu.pl/~ens

*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, secretary of the Committee of Automation and Robotics of Polish Academy of Sciences (PAN).

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

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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)

**Systems Control Division, Biometrics and Machine Learning Group**
**room 522, tel. 22 234 7733**
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*M.Sc. 1969, Ph.D. 1975, D.Sc. 2000 from WUT, the title of Professor of Technical Sciences awarded in December 2010.*

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

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

**Piotr Pałka** Assistant Professor

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

With WUT since 2009.

*Interests:* Multi-agent systems, mechanism design, incentive compatibility.

**Krzysztof Pieńkosz** Assistant Professor

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*M.Sc. 1984, Ph.D. 1992, D.Sc. 2011 from WUT.*

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

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

**Grzegorz Płoszajski** Assistant Professor (part time)

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*M.Sc. 1968 from WUT, M.Sc. in Mathematics 1974 from Warsaw University, Ph.D. 1974 from WUT.*

With WUT since 1969. Deputy Director for Information Technology of the Main Library of WUT since 1996. Committee Member of 'Kasa Mianowskiego' since 2004.

*Interests:* Information retrieval, text algorithms, operation research, digitalization standards, library automation, classification.

**Joanna Putz-Leszczyńska** Assistant Professor (part-time)

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*M.Sc. 2004, Ph.D. 2010 from WUT.*

Since 1999 she is with Warsaw University of Technology, presently being an assistant professor at the Institute of Control and Computation Engineering. Since 2003 she works as a research assistant at Biometric Laboratory of Research and Academic Computer Network NASK.

*Interests:* Biometrics, identification, security and global optimization heuristics

**Andrzej Ratkowski** Assistant Professor

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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.

**Tadeusz Rogowski** Senior Lecturer (part-time, until Nov. 2013)

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*M.Sc. 1972 from WUT.*

With WUT since 1972, Director of University Computer Center (1989-2002, 2008–).

*Interests:* Computer network, programming languages, operating systems.

**Krzysztof Sacha** Professor (Leader of the Group)

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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. 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 Lingby, Denmark (1993), Project Manager in Alerton (1999-2002), Advisor to the President of Social Insurance Institution (2005-2009). Head of the Institute of Software Engineering at Vistula University, Warsaw, Poland. Member of the Council of the National Centre for Research and Development (from 2010). Expert in maintaining and evaluating software projects. Member of IEEE Computer Society.

*Interests:* Software engineering, software quality evaluation, software security, trust management, real-time systems.

**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.

**Andrzej Stachurski** Assistant Professor

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

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

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

**Marcin Szlenk** Assistant Professor

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

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

**Wojciech Szynkiewicz** Assistant Professor

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

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

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

**Tomasz Śliwiński** Assistant Professor

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

With WUT since 2004.

*Interests:* Discrete optimisation, operations research, decision support.

**Piotr Tatjewski** Professor (Head of Division)

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With Warsaw University of Technology since 1972. Head of Control Engineering Group since 1991, 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 the Journal PAK, 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–).

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

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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.

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

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*Interests:* Predictive control, synthesis of control systems, symbolic calculations, operating systems.

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*M.Sc. 2001 from WUT and 2004 from Warsaw University, Ph.D. 2005 from WUT.*

With WUT since 2005.

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

**Tomasz Winiarski** Assistant Professor

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

With WUT since 2004.

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

**Adam Woźniak** Reader (until Feb. 2013, Ass Prof, since March 2013)

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*M.Sc. 1970, Ph.D. 1975 from WUT.*

With WUT since 1970. Advisor to the Dean of Faculty for Departmental Libraries (1987–1993 and 1999–2002), Member of WUT Library Council (1999–2012), Member of WUT Committee for Student Admissions (2001-2002), Dean's Coordinator for Graduate Distance Learning (2005–2008).

*Interests:* Control of complex systems, servomechanisms, robot control, multi-criteria optimization, game theory, multiagent systems including mechanism design and auctions, decision support systems.

**Andrzej Zalewski** Assistant Professor

**Control and Software Engineering Division, Software Engineering Group**
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*M.Sc. 1997, Ph.D. 2003 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 (Director of the Institute, Leader of the Group)

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

With WUT since 1985. Research visitor at Loughborough University of Technology, UK (1990, 1992), Senior Fellow at Nanyang Technological University, Singapore (1999-2001), Secretary of Priority Research Program in Control, Information Technology, and Automation (PATIA) (1994–1999). Member of the Forecast Committee of the Polish Academy of Sciences: Poland 2000 Plus (2003–2007). Senior Member of IEEE (2002–). 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–). 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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*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

**Marcin Chochowski** Assistant (part-time; until Sept 2013),

**Systems Control Division, Biometrics and Machine Learning Group**
**room 558, tel. 22 234 7805**
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*M. Sc. 2004 from WUT*

With WUT since 2011

*Interests:* biometrics, image processing, classification tasks, machine learning

**Jarosław Hurkała** Software Engineer (part-time, since Jul. 2013)

**Systems Control Division, Robot Programming and Pattern Recognition Group**
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**Włodzimierz Macewicz** Senior Software Engineer

**Control and Software Engineering Division, Software Engineering Group**
**room 525, tel. 22 234 7699**
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*M.Sc. 1983 from WUT.*

With WUT since 1983.

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

**Michał Walęcki** Software Engineer (since Apr. 2013), Assistant (until Feb 2013)

**Systems Control Division, Robot Programming and Pattern Recognition Group**
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*M.Sc from WUT.*

With WUT since 2010.

*Interests:* Design of microprocessor-based control and measurement systems, automatic control.

## 2.4 Ph.D. Students

**Krzysztof Daniluk** Ph.D. Student

**Systems Control Division, Complex Systems Group**
**room 573, tel. 22 234 7126**
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*Supervisor:* Ewa Niewiadomska-Szynkiewicz

**Piotr Hubert Ekes** Ph.D. Student (since October 2013)

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*Supervisor:* Andrzej Pacut

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*Supervisor:* Krzysztof Sacha

**Jarosław Hurkała** Ph.D. Student

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**Jan Kurnatowski** Ph.D. Student (until March 2013)

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**Krzysztof Lasota** Ph.D. Student

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*Supervisor:* Ewa Niewiadomska-Szynkiewicz

**Tomasz Leś** Ph.D. Student (until March 2013)

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**Piotr Modliński** Ph.D. Student (until Oct. 2013)

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**Maciej Stefańczyk** Ph.D. Student

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*Supervisor:* Piotr Tatjewski

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*Supervisor:* Piotr Tatjewski

## 2.5 Administrative and Technical Staff

**Teresa Bortkiewicz** Manager, Finances.

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**Maria Graszka** Office support (part-time; until Apr. 2013).

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**Elżbieta Matyjasiak** Secretary, Main office.

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

**Bohdan Murzynowski** Technical support (until Aug. 2013).

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**Jolanta Niedbało** Office support.

**room 521, tel. 22 234 7397**
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**Agnieszka Paprocka** Finances support.

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*M.Sc. 2008 from Cardinal Stefan Wyszyński University in Warsaw.*

**Sylwia Piskorska** R&D Specialist (since Nov. 2013).

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*M.Sc. 2012 from Technical University of Gdańsk.*

**Agnieszka Słojewska** Finances specialist.

**room 556, tel. 22 234 6096**
A.Slojewska@ia.pw.edu.pl

*baccalaureate 2005 from Leon Kozmiński Academy of Entrepreneurship and Management*

**Ryszard Tchórz** Technical support (part-time, until June 2013).

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**Alicja Trojanowska** Secretary, Student affairs.

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**Beata Woźniak** Manager, Administration.

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# 3 Teaching Activities – Academic Year 2012/2013

## 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 (fall) |
| Administration of UNIX and TCP/IP | ASU | 2 – 1 – | OSK, OT, MERJ | J.Sobczyk (spring/fall) |
| Algorithms and Data Structures | AISDI | 2 – 1 – | sem.3 | A.Zalewski (spring) |
| Artificial Intelligence | EAI | 2 – – – | ANGL, OT | W Kasprzak (spring). |
| 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.Czajka (spring/ fall) |
| Commercial Data Bases 2 | KBD2 | 2 – – 2 | BDSI, OT | T.Traczyk (spring)/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) |
| Control | ECONT | 2 1 1 – | ANGL, OT | P.Domański (spring/fall) |
| Data Bases 2 | BD2 | 2 – – 1 | BDSI, OT, SIDJ, PP-SID | T.Traczyk (spring/fall) |
| Decisions in Competition Environment | DWW | 2 – – 1 | | A.Woźniak (spring) |
| 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 | EDYSY | 2 – 2 – | ANGL, OT | M.Ławryńczuk, (spring) P.Marusak (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) G.Płoszajski (fall) |
| Fundamentals of Optimization | POPTY | 2 – 2 – | MKPWD, OT, PP-SID | A.Stachurski (spring/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 | J.Putz – Leszczyńska (spring) |
| Group Project | | | 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) |
| 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) |
| Numerical Methods | ENUME | 2 – 2 – | ANGL, OT | P.Marusak (fall) |
| Management IT Systems | SIZ | 2 – – 2 | MKPWD, OT, SWDJ | J.Granat (spring/fall) |
| Mobile Robots | EMOR | | ANGL, ECETC, OT | W.Szynkiewicz (spring) |
| Modeling and Control of Manipulators | EMOMA | 3 1 – – | Emaro | C.Zieliński (fall) |
| Operating System | EOPSY | 2 1 1 – | ANGL, OT | T.Kruk (fall) |
| Optimization Techniques | EOPT | | Emaro | W.Ogryczak (spring) |

| Course Title | Course code | Hours per week | Class | Lecturer |
|---|---|---|---|---|
| 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) |
| Principles of Computer Science | EPCOS | 2 – – – | ANGL, OT | W.Kasprzak (fall) |
| Process Control | STP | 2 1 1 – | OT, PSTER | P.Marusak (fall) |
| Process Management and Scheduling | ZAH | 2 – 2 – | MKPWD, OT, MUS, PP-SID, SWDJ | E.Toczyłowski (spring/fall) |
| Programmable Controllers | SP | 2 – 1 – | MUS, OT, METJ | M.Kaleta (fall) |
| Programming 2 | EPRO2 | 2 – 2 – | ANGL, OT | A.Stachurski (spring/fall) |
| Real-time Systems | ERTS | 2 – – 1 | EMARO | B. Kubica (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 |
| Synthesis of Decision Rules | SRD | 2 – 2 – | MKPWD, OT, PP-SID, SIDJ | K.Malinowski (spring/fall) |
| Architektura I integracja systemów | AIS | 2 – 1 – | PZ-OWJ, PZ-OTI | A.Ratkowski (spring) |
| Programming Fundamentals | EPFU | 2 1 1 – | ANGL, OT | M.Kaleta (spring/fall) |
| Rozproszone systemy operacyjne | RSO | 2 – 1 – | PZ-OWJ, PZ-SID, OT | T.Kruk (spring) |
| Inteligentne systemy robotyczne | ISR | 2 – 1 – | PZ-AIR, PZ-OWJ, PZ-SID, PZ-A, OT | C.Zieliński (fall) |
| Programowanie obiektowe | PROI | 2 – 2 – | MPRIA, OT | M.Warchoł (fall) |
| Rozpoznawanie obrazów i sygnałów mowy | ROSM | 2 – – 1 | PZ-OWJ, PZ-SID, OT | W. Kasprzak (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 **Engineering of Management Information Systems and Decision Support Systems** are intended for IT specialists, who want to broaden their skills in field of MIS and DSS. The programme contains: management information systems (with special attention on SAP system and ABAP language), modeling of processes and data structures, engineering of information systems, decision support and business intelligence systems, data management systems, aplications of MIS and DSS (including service science and MRP). The classes take form of lectures and laboratories.

Postgraduate studies **IT Systems Security and Biometrics** are aimed at providing knowledge related to the most important aspects of IT systems security, in particular including access control, physical security, cryptography, applications and operational security, biometrics, security evaluation and certification, security management and auditing, as well as legal, ethical and social aspects of biometrics and security. Lectures are supplemented by laboratory classes, organized in recently renewed Biometrics and Machine Learning Laboratory, lavishly equipped with topical biometric systems, measurement devices and software.

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] Large scale integrate 7 FP UE grant. ICT-2009.1.1: The Network of the Future.
FP7–ICT–2009–5: **Low Energy Consumption NETworks (ECONET)**.
Granting period: 01.10.2010 – 30.09.2013.
Principal Investigators (WUT): Ewa Niewiadomska-Szynkiewicz, and Krzysztof Malinowski.
Investigators: Michał Karpowicz, Michał Marks, Andrzej Sikora, Krzysztof Daniluk, Marcin Mincer.
Partners: Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Italy) – coordinator, Mellanox Technologies Ltd (Israel), Alcatel-Lucent Italia S.p.A. (Italy), Lantiq (Germany), Ericsson Telecomunicazioni S.p.A. (Italy), Telecom Italia (Italy), Greek Research & Technology Network (Greece), NASK (Poland), Dublin City University (Irland), VTT (Finland), Warsaw University of Technology (Poland), NetVisor (Hungary), Ethernity Networks Ltd (Israel), LightComm S.r.l. (Italy), Infocom (Italy).

Aim of the project: The concept of energy-efficient networking has begun to spread over the past few years, gaining increasing popularity. Besides the widespread sensitivity to ecological issues, such interest also springs from economical needs, since both energy cost and electrical requirements show a continuous growing trend. In order to support next generation network infrastructures and related services for a rapidly increasing customer population, telecoms and service providers need to rapidly deploy ultra high capacity optical transport/access networks and efficiently exploit converged service capability in heterogeneous access. The sole introduction of low consumption silicon technologies may not be enough to effectively curb energy requirements. For disruptively boosting the network energy efficiency, these hardware enhancements must be integrated with ad-hoc mechanisms that explicitly manage energy saving by exploiting network-specific features. ECONET aims at studying innovative techniques and architectural solutions to support energy efficiency in next generation networks. The overall idea is to introduce novel green network-specific paradigms and concepts enabling the reduction of energy requirements of wired network equipment with respect to the business-as-usual scenario.

Expected results: The expected results of the ECONET project will cover three main research axes. In the first axis, novel network-specific HW/FW technologies will be developed to optimize the power management features. The second axis will be devoted to develop local and distributed frameworks for dynamic optimization of the trade-off between energy consumption and network performance. The last axis will focus on the design of a Green Abstraction Layer for interfacing the novel low-level green capabilities with OAM frameworks in a common and standard way. The ECONET project will deliver novel energy-aware device prototypes on which large-scale demonstration tests will be conducted. The project will aim at maximizing its impact on industrial and network operator communities as well as on standardization bodies.

Keywords: computer networks, green networking, low consumption communications, energy efficiency.

[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).

Project coordinator from WUT: Cezary Zieliński.

Investigators from WUT: Wojciech Szynkiewicz, Włodzimierz Kasprzak, Tomasz Michał Kornuta, Tomasz Winiarski, Michał Walęcki, Maciej Stefańczyk.

Aim of the project: RAPP (Robotic Applications for Delivering Smart User Empowering Applications) will provide a software platform in order to support the creation and delivery of robotics applications (RAPPs) targeted to people at risk of exclusion, especially older people. The open-source software platform will provide 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 stack with added functionalities suitable for different kinds of robots. RAPP will expand the computational and storage capabilities of robots and enable 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 will assist developers is creating improved applications for different types of robots that target to 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 will be 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.

Expected results: Provide an infrastructure for developers of robotic applications, so they can easily build and include machine learning and personalization techniques to their applications Create a repository, from which robots can download Robotic Applications (RApps) and upload useful monitoring information Develop a methodology for knowledge representation and reasoning in robotics and automation, which will allow unambiguous knowledge transfer and reuse among groups of humans, robots, and other artificial systems Create RApps based on adaptation to individuals and taking into account the special needs of elderly people, while respecting their autonomy and privacy Validate 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] MNiSW Grant No. N N516 532139 **A Methodology for the Evolution and Development of Service-oriented Systems**.
Granting period: 28.10.2010 – 27.04.2013.
Principal investigator: Andrzej Zalewski.

Aim of the project: The purpose of the grant obtained from the Ministry of Science and Higher Education is to the develop a methodology focused on the support of perpetual evolvement of modern SOA systems rather than just their initial construction. The methodology shall consists of: models and methods for change specification and modeling, change impact analysis techniques, change impact assessment method based on GQM scheme, transformational change implementation basing on formal models built upon LOTOS, change documentation based on GQM scheme as well as role-base trust management mechanisms and models.

Expected results: the methodology for evolving service-oriented systems, the model for documenting evolution of service-oriented systems with architectural decisions, the change assessment scheme supporting decision-making process, the evolution process defining activities made during evolution steps.

Keywords: service-oriented architecture, software evolution, architectural decisions

[PR4] MNiSW Grant No. N N514 044438: **Development of incentive compatible models and mechanisms in multi-agent systems**.

Granting period 2.04.2010 – 1.04.2013.
Principal investigator: Eugeniusz Toczyłowski.

Aim of the project: The goal of the project is analysis, development, and evaluation of different aspects and properties of the market models, mechanisms, and decision making processes in the complex market systems. The research on different features and applications of the market mechanisms are conducted. Particularly complex, multistage, long-term, multi-commodity, infrastructural constrained markets are deeply analyzed. Complex models, mechanisms which are characterized by desirable properties, e.g. harmonizing goals of particular market participants, groups of them, all the society, a market designer, a regulator, and also interested exterior entities (e.g. government, governmental /nongovernmental/ supranational institutions) are analyzed, developed, and verified.

Expected results: During the work under the project following effects was reached. Significant criteria for evaluation of the market mechanisms were gathered and formulated. The methodology for market mechanism analyzing was proposed. Market mechanisms guaranteeing efficiency and incentive compatibility for simple, unconstrained exchanges was reviewed. The preliminary studies of the models ensuring robustness against collusion, or coalition formation, were done. The auctions of time, and iterative auction were reviewed. The models complying uncertainty of supply goods and services, and multicriteriality in the models of preferences of market participants, were studied. Proposed models and mechanisms in a following areas were deeply analyzed. In the area of the environmental protection, in particular the market for greenhouse gases emission permits was studied. In the energy area, particularly models for balancing electricity market was evaluated. In the telecommunication field, the models for bandwidth trading, and routing algorithms for delay and disruptive tolerant networks that uses the mechanism theory, was analyzed. Outlined above issues relate to efficient and incentive compatible models, mechanisms, and processes.

Keywords: multi-agent systems, incentive compatibility, game theory, market mechanism theory, multi-criteria modeling.

[PR5] NCBiR Grant No. O R0B 0027 01: **Biometrics and PKI techniques of modern identity documents and protection of information systems (BIO-PKI)**.
Granting period: 28.12.2011 – 28.12.2013.
Project coordinator: Andrzej Pacut. Principal investigator: Włodzimierz Kasprzak.

Investigators (from ICCE): Włodzimierz Ogryczak, Marcin Chochowski, Adam Czajka, Joanna Putz-Leszczyńska, Maciej Stefańczyk.

Aim of the project: The goal of this project is to build solutions supporting provision of advanced services related to identity documents. A modern identity document can be regarded in terms of both technical solutions implemented in the document processing system and external systems and services that support it. Therefore, the R&D activities of this project put equal pressure on the document CPU technologies and support systems such as PKI and biometrics. The project addresses the challenges associated with the integration of identification documents, biometrics and security techniques for personal data given either in paper or electronic form. In particular, at the Warsaw University of Technology mechanisms for biometric data protection are elaborated, by ensuring the security of their storage, transmission and processing. These mechanisms are based on solutions in cryptography, biometrics and steganography.

Expected results: The final deliverable of this project will be a number of demonstrators, which will provide sample implementations of the developed solutions: The procedures for safe delivery of on-line services to ID holders. These procedures will form a basis for an implementation of tools for identity documents and service providers. Various biometric and steganography techniques which allow for better linkage of identity with their owners, enriching and improving of multi-factor authentication process. At the same time, it allows for better automation, improved efficiency and convenience of identity identification and verification, and additional protection against fraud.

Keywords: biometric identification, cryptography, document security, face recognition, image steganography/watermarking, PKI systems

[PR6] NCBiR Grant No. DOBR/0071/R/ID1/2012/03: **Development of a system enabling digitization, long-term storage, management and making available in secure electronic form of documents and archival materials**.
Granting period: 20.12.2012–19.12.2014.
Principal investigator: Tomasz Piotrowski (NASK)
Principal investigator from WUT: Ewa Niewiadomska-Szynkiewicz, Adam Kozakiewicz.
Investigators: Mariusz Kamola, Paweł Szałachowski, Krzysztof Daniluk.

Aim of the project: Development of a modern, fully functional solution supporting the process of digitization, long-term archivization and secure access to classified documents. Detailed goals: preparation of procedures for the process of digitization of documents and archival materials: research and deployment of hardware-software solutions supporting the process of digitization, design and development of a system supporting the process of digitization automating the acquisition of metadata of the digitized objects, implementation of a system with the functionality of a long-term storage archive with advanced mechanisms for making available, searching and access control, design and practical exploitation in the developed software of methods for secure storage of digital content employing advanced cryptographical algorithms, preparation of a long-term storage policy, encompassing the issues of medium and data format migration, implementation of methods and algorithms ensuring authenticity and integrity od both individual resources and the archive as a whole, preparation and execution of integration of the developed system with existing systems for flow, processing and storage of documents and digital resources, design of rooms for hardware infrastructure for digitization and storage of classified documents and digital materials, design and extension of workstations and network for sharing of classified archival documents and archival materials, testing and demonstration of the prototype of the system in operational conditions, training of the systemñs users.

Expected results: The planned final result of the project will be the development of a complete hardware-software solution supporting the process of digitization, long-term archiving and secure sharing of documents, ready to be deployed in all institutions maintaining archives of classified documents and complying with all regulations applicable to this kind of archives. The software developed as part of the project will comprise of the following elements: a module supporting the process of digitization, automating the acquisition of metadata of the objects being digitized, a module providing the function of a long-term storage archive, equipped with advanced sharing, search and access control mechanisms, a module integrating the archive with existing document and digital materials flow, processing and storage systems. Digitization support will include both the ability of selective entry of individual documents and mass import. This will make the system capable of fast data import on startup as well as regular entry of newly created documents. The main characteristics of the module implementing the function of a long-term storage archive will include: support for execution of procedures specified in the protection of classified information act regarding periodic review of stored classified materials, security of stored data, ability to retrieve the complete history of documents, ability to search the archive based on both metadata values and document content, capability of remote access to any group of documents, following the security policies in force, scalability and stability.

Keywords: digitization, archiving, long-term storage, classified documents, cryptography.

[PR7] NCBiR Project No. PBS1/A3/8/2012: RobREx: **Autonomy for rescue and exploration robots**.
Granting period: 12.12.2012–30.11.2015.
Partners: Industrial Research Institute for Automation and Measurements – PIAP, Warsaw University of Technology, Łódź University of Technology, Wrocław University of Technology,

Poznań University of Technology, Institute of Computer Science of the Polish Academy of Sciences. Principal investigator from WUT: Cezary Zieliński.

Investigators: Włodzimierz Kasprzak, Wojciech Szynkiewicz, Tomasz Winiarski, Tomasz Kornuta, Michał Walęcki, Maciej Stefańczyk.

Aim of the project: Development of technologies enabling the creation of autonomous robots, specifically for rescue and exploration tasks. Current rescue and exploration robots (RERs), including those manufactured by PIAP, are teleoperated, what significantly limits their operating range and requires constant human supervision. The conducted market analysis shows that in the near future the demand for autonomous devices will dominate. The goal of the project is to produce a set of technologies and an adequate architecture necessary for the production of autonomous RERs, or in general service and field robots. In particular, the project will deliver technologies enabling: perception of the environment; navigation and control of mobile platforms and manipulators; impedance control of manipulators and grippers; intelligent two-handed manipulation; active sensing and the use of ontology common to people and robots. The results will be demonstrated on two robots: a mobile manipulator SCOUT/GRYF manufactured by PIAP and a two-handed robot manipulator. The team from the Institute of Control and Computation Engineering of the Faculty of Electronics and Information Technology of Warsaw University of Technology is responsible for creation of technologies for intelligent two-handed manipulation and active sensing.

Expected results: A set of technologies enabling the creation of autonomous robots, specifically for rescue and exploration tasks.

Keywords: rescue robots, exploration robots, robot autonomous behaviors, two-handed manipulation, active sensing, perception

[PR8] NCN grant No N N514 672940: **Methods and tools for ad hoc network design and control**.
Granting period: 04.04.2011 – 03.04.2014.
Principal Investigator: Ewa Niewiadomska-Szynkiewicz.
Investigators Krzysztof Malinowski, Andrzej Sikora, Michał Marks, Mariusz Kamola, Piotr Arabas, Adam Woźniak, Krzysztof Daniluk, Krzysztof Lasota.

Aim of the project: The ad hoc networking is an ultimate technology in wireless communication that allows wireless devices located within their transmission range to communicate directly to each other without the need for established fixed network infrastructure. It is a new area of research that has become extremely popular over the last decade and is rapidly increasing its advance into different areas of technology. Ad hoc networks are growing rapidly in both size and complexity, and it is becoming increasingly difficult to develop and investigate such large and complex systems. The project concerns the important problems related to ad hoc networks design and development. Two types of networks are considered: WSN - Wireless Sensor Networks and MANET ℓ Mobile Ad hoc Networks. The focus is on three key aspects of the design: accurate localization of devices that form a network, reliable and energy aware inter-node communication and managing the mobility of an ad hoc network. The main goal of the project is to design and develop new methods, algorithms and protocols for ad hoc network applications. The second objective is to develop a software tool for ad hoc networks simulation and create laboratory for testing solutions for wireless sensor networks.

Expected results: The project will deliver novel protocols for reliable and energy-aware inter-node communication and the localization system for calculating the geographic position of devices that form a network. The effectiveness of both new solutions will be tested through simulation and in a testbed network. A comprehensive approach for design of cooperative, fully connected self-organizing networks will be provided. The novel algorithm for efficient calculating of motion trajectories for wireless devices will be developed and evaluated. Moreover, the software platform for parallel and distributed simulation, and computer-aided design of self-organizing mobile networks will be delivered. Finally, the wireless sensor network laboratory will be built in which

demonstration tests will be conducted. The results of the project will be described in the research papers, a book devoted to ad hoc network design and development, and presented on conferences. Both network simulator and WSN laboratory will be used for research and education.

Keywords: ad hoc network, wireless sensor network (WNS), MANET, localization system, mobility model, topology control, energy-efficient communication, optimization, simulation.

[PR9] NCBiR Grant No. POIG.01.03.01–00–071/12: **Development and construction of the controller for the air-water heat pump**, Project financed from EU funds within the Operational Program Innovative Economy (POIG).

Granting period: 01.04.2013 – 31.03.2015.

Coordinator: Warsaw University of Technology. Partner: Plum Sp. z o.o.

Project coordinator from WUT: Piotr Tatjewski.

Investigators from WUT: Piotr Marusak, Maciej Ławryńczuk, Marian Rubik, Piotr Ziętek.

Aim of the project: Development of the industrial feedback controller for air-water heat pumps, maximizing operation efficiency. The problem is of economic and also ecological importance, leading to reduction of usage of conventional energy sources. The control of air-water heat pumps is more difficult than other types of heat pumps (ground-water or water-water pumps), due to significant changes of air temperature and humidity, including also frost effects during winter. The following tasks are planned within the grant: detailed development of design specifications to be achieved, construction and identification of adequate models of the heat pump, development of feedback control algorithms with special focus on adaptive and predictive-type algorithms, development of the control algorithms and supervisory optimization for cascade structure of heat pumps, verification of constructed controllers, preparation of tuning procedures. The design of a multivariable controller is planned (with two input and two output variables).

Expected results: Feedback control algorithms for air-water heat pumps, including cascade configuration of pumps, are to be developed. Measurements, model verification and controller implementation and testing will be carried out on a research stand constructed by the industrial partner, the Plum company. The industrial partner will develop and implement to production the industrial microprocessor based controller for the air-water heat pumps, implementing the designed algorithms.

Keywords: renewable energy, air-water heat pump, model identification, feedback control, microprocessor control.

[PR10] NCBiR Grant No. POIG.01.03.01–14–076/12: **Decision Support System for Large-Scale Periodic Vehicle Routing and Scheduling Problems with Complex Constraints,**

Project financed from EU funds within the Operational Program Innovative Economy (POIG).

Granting period: 23–05–2013 30–06–2015.

Coordinator: Warsaw University of Technology. Partners: SMT Software S.A. Wrocław.

Project coordinator from WUT: Włodzimierz Ogryczak.

Principal Investigators from WUT: Tomasz Śliwiński, Jarosław Hurkała, Mariusz Kaleta, Piotr Pałka.

Aim of the project: Development of algorithms for large-scale periodic time-dependent vehicle routing and scheduling problems with complex nonuniform constraints with respect to frequency, time windows, working time, etc. With additional fast adaptive procedures for operational rescheduling of plans in presence of various disturbances. Application of algorithms within a system supporting planning and management of mobile personnel (sales representatives and others).

Expected results: Advanced decision support system for large-scale periodic time-dependent vehicle routing and scheduling problems with complex constraints supporting planning and management of mobile personnel tasks.

Keywords: decision support, optimization, vehicle routing, scheduling, algorithm.

[PR11] NCBiR Grant DEMONSTRATOR+ No. WND–DEM–1–385/00: **Digital Document Repository CREDO.**

Granting period: 01.11.2013–31.03.2016.

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: Grzegorz Płoszajski, Bartosz Kozłowski, Piotr Pałka.

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.

[PR12] 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 A. 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.

[PR13] 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 31–01–2016.

Principal investigator: Tomasz Winiarski.

Investigators: Cezary Zieliński, Tomasz Kornuta, Michał Walęcki, Maciej Stefańczyk, Łukasz Żmuda, Konrad Banachowicz, Dawid Seredyński.

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.

[PR14] Industrial research agreement No. 501/E/1031/112 with SORTER SJ: **Fruit sorting robot controller.**

Granting period: 10–06–2013 31–12–2014.

Principal investigator: Cezary Zieliński.

Investigators: Włodzimierz Kasprzak, Wojciech Szynkiewicz, Tomasz Winiarski, Tomasz M. Kornuta, Michał Walęcki, Maciej Stefańczyk.

Aim of the project: Design of the robot controller and the creation of a programming language, in which the user will be able to express the task that the robot has to execute.

Expected results: The robot will be controlled using position-force mode, utilizing trajectory generation both in operational and configuration space. It will have separate perception units, effector control drivers and a control subsystem responsible for edition and interpretation of the user program (task).

Keywords: universal robot controller, fruit sorting robot.

[PR15] Industrial research agreement No. 501/E/1031/0113 with SORTER SJ: **Vision based fruit inspection and sorting.**

Granting period: 10–06–2013 31–12–2014.

Principal investigator: Włodzimierz Kasprzak.

Investigators: Cezary Zieliński, Wojciech Szynkiewicz, Tomasz Winiarski, Tomasz Michał Kornuta, Michał Walęcki, Maciej Stefańczyk, Piotr Pałka.

Aim of the project: The project concentrates on the vision subsystem, which will cooperate with the aforementioned robot controller. The vision subsystem should evaluate the quality and an optimal grasp location of a fruit (e.g. an apple) being transferred by a conveyor. Low grade fruits should be discarded, while those of appropriate quality should be grasped in such a way that they can be placed in the box with the most attractive side facing the top (e.g. in the case of multi-coloured apples, the red side should face the top).

Keywords: universal robot controller, vision system, fruit sorting robot.

[PR16] Industrial research agreement No. 501/G/1031/0111 with ILABO: **System for Monitoring, Analysis and Reporting of Production line efficiency SMARP.**

Granting period: 11–02–2013 30–11–2013.

Principal investigator: Krzysztof Sacha.

Investigator: Adam Hurkała.

Aim of the project: Defining a language for specification of production lines and the data acquired and processed in a web-based manufacturing execution system SMARP.

Expected results: A language for SMARP specification.

Keywords: web-based manufacturing execution system, MES, e-SCADA, XML.

[PR17] Research agreement No. 501/H/1031/0114 with ZUS: **Evaluation of a contract for the support service of Complex Information System in Social Insurance Institution.**

Granting period: 01–10–2013 14–11–2013.

Principal investigator: Krzysztof Sacha.

Investigators: Andrzej Zalewski, Szymon Kijas.

Aim of the project: Analysis and evaluation of the contract.

Expected results: Evaluation report.

Keywords: social insurance, complex information system, evaluation report.

[PR18] Research agreement No. 501/H/1031/0115 with Ministry of Justice: **Expert's opinion regarding electronic monitoring system used by the criminal justice agencies.**

Principal investigator: Andrzej Zalewski.

Aim of the project: Analysis and assessment of the possibility of maintaining the electronic monitoring system by a third-party company.

Expected results: Expert's opinion.

Keywords: electronic monitoring, Public Procurement Law.

[PR19] Dean's grant No. 504M0013: **Efficient automatic generation and verification of signatures of active threats**.

Granting period: 30.06.2012–31.03.2013.
Principal Investigator: Adam Kozakiewicz.

Aim of the project: Increasing knowledge and obtaining new scientific results in the field of security of systems and networks, focusing on the problem specified in the grant's title, namely automatic generation and efficient verification of threat signatures and application of machine learning and artificial intelligence methods to this problem, Preparation of a laboratory for further research in the field of network security, Publication of results leading to habilitation.

Expected results: Review of the literature on the issue of syntactic signature generation and verification, purchase of laboratory equipment enabling research on malicious software in secure, isolated environment, development of generation and verification methods with the goal of increasing selectivity and sensitivity of signatures, increasing the performance of signature generation and verification methods through multicore parallel processing and use of GPU, documentation of results in reports, preparation of papers to be published in journals. Research on enhancement of signatures generated by multiset algorithms was performed, A parallel version of a signature generator was implemented.

Keywords: detection of network threats, automatic generation of signatures, honeypots.

[PR20] Dean's Grant No. 504M/0045: **Active torso for a service robot.**

Granting period: 01–07–2013 31–12–2013.

Principal investigator: Michał Walęcki.

Investigator: Rafał Chojecki.

Aim of the project: The aim of the project was to adapt two-arm Velma service robot to operate in typical human environment. Typical service robot's tasks include reaching into kitchen cabinets hanging on the wall, door opening, manipulation of objects lying on the table etc. To cope with these tasks, Velma robot's manipulation space had to extended and some basic robot portability had to be introduced.

Expected results: Within the project an active torso with two degrees of freedom was developed for Velma robot. It has two degrees of freedom. A rotary joint is torque-controlled, which allows impedance control of full kinematic chain in such tasks as door opening. The second joint enables the robot to lean over the table to perform manipulation tasks. The torso is equipped with electric motors driven by specially designed motor controllers, integrated with ROS system that controls the whole robot system.

Keywords: service robots, motion control, agent-based systems.

[PR21] Dean's Grant No. 504M/0046: **Control of the service robot degrees of freedom.**

Granting period: 01–07–2013 31–12–2013.

Principal investigator: Tomasz Winiarski.

Investigators: Maciej Ławryńczuk, Michał Walęcki, Bartosz Świstak.

Aim of the project: The main project goal was torque controller synthesis for single degree of freedom of service robot. The grant was synergic to the other dean grant regarding development of hardware of active rotational torso of two arm manipulation system. The control method developed here will be utilized after both grants end, hence at the beginning of 2014, for control of the new active torso of two arm robot. This will result in about half of the year shortening of the launch of the new two arm robot, because the most of the preliminary work was executed on the existing Sarkofag robot. The new torso extends the workspace of two KUKA LWR manipulators as well as theirs manipulatibility for permissible configurations, that in particular will make the execution and research of new applications possible. The new controllers will be also utilized in indirect controller of IRb6 manipulators.

Expected results: proposal of analytical model of control plant and state observer with estimation of friction and gravitational force adapted for simulation purpose, development of MATLAB simulation model, state observer analysis, adaptation of test bed – Sarkofag robot (production of electronic axis controllers and purchase of communication interface PC card) experimental identification of model parameters, proposal of controller basing on simulation, model verification on real, single degree of freedom.

Keywords: robotics, control theory.

[PR22] Dean's Grant No. 504M/0044: **Utilization of probabilistic graphical models in the process of object recognition for the purpose of active perception of a service robot.**

Granting period: 01–07–2013 31–12–2013.

Principal investigator: Tomasz Michał Kornuta.

Investigators: Michał Laszkowski, Karol Katerżawa, Łukasz Żmuda, Rafał Chojecki (Faculty of Mechatronics WUT), Artur Wilkowski (GiK WUT, PIAP), Maciej Stefańczyk.

Aim of the project: The aim of the work was to develop algorithms enabling the visual perception of service robots based on processing of RGB-D images and probabilistic inference.

Expected results: The main result of the grant is the development of models of three-dimensional objects with the inference based on the probabilistic theory. These models enable a service robot to actively explore its surroundings. The considered scenario included manipulation of objects with internal degrees of freedom. As a part of the research we developed a process of aggregation of object model on the basis of several views, a method to identification of instances of objects based on a database of models and mechanisms for hypotheses evaluation regarding objects present in the scene based on Bayesian network.

Keywords: robot perception, computer vision, object recognition, point clouds, RGB-D images, probabilistic graphical models.

[PR23] Statutory Grant No. 504G036300: **Development of methodology of control, decision support and production management**.
Granting period: 14.05.2012 – 31.10.2013, 28.06.2013 – 31.10.2014.
Principal investigators: Ewa Niewiadomska-Szynkiewicz, Andrzej Pacut, Włodzimierz Ogryczak, Krzysztof Sacha, Piotr Tatjewski, Eugeniusz Toczyłowski, Cezary Zieliński.

# 5 Degrees Awarded

## 5.1 D.Sc. Degrees

Andrzej Stachurski
*Aproksymacje kwadratowe w ciągłej optymalizacji nieliniowej*
Degree awarded on November 19, 2013

Maciej Ławryńczuk
*Sieci neuronowe w efektywnych obliczeniowo algorytmach regulacji predykcyjnej*
Degree awarded on February 19, 2013

## 5.2 Ph.D. Degrees

Advisor: **prof. dr hab. inż. Eugeniusz Toczyłowski**

Przemysław Kacprzak
*Modele optymalizacyjne wspomagania efektywnego handlu energią elektryczną z wykorzystaniem obrotu wielotowarowego*
Thesis defended on June 27, 2013

Advisor: **prof. dr hab. inż. Cezary Zieliński**

Tomasz Kornuta
*Desing of Structures and Behaviours of Robot Control Systems Using Active Vision*
Thesis defended on June 4, 2013

Advisor: **prof. dr hab. inż. Andrzej Wierzbicki**

Paweł Białoń
*Solwery nieliniowe w systemach optymalizacji i wspomagania decyzji*
Thesis defended on February 19, 2013

Advisor: **prof. dr hab. inż. Cezary Zieliński**

Piotr Trojanek
*Design and Implementation of Robot Control Systems Reacting to Asynchronous Events*
Thesis defended on February 19, 2013

## 5.3 M.Sc. Degrees

Advisor: **Adam Czajka**

P. Bulwan
*Automatyczny dobór parametrów kodowania falkowego tęczówki*
Degree awarded on October 2013

K. Kozioł
*Testowanie autentyczności palca z wykorzystaniem analizy obrazu żył*
Degree awarded on October 2013 (with honors)

Advisor: **Włodzimierz Dąbrowski (Wydział Elektryczny)**

B. Jeż OKNO
*Optymalizacja wydajności systemów bazodanowych w oparciu o Sybase Adaptive Server Enterprise*
Degree awarded on March 2013

Advisor: **Paweł Domański**

D. Dytko
*Audiovisual Quality Model for progressive download applications*
Degree awarded on October 2013

Advisor: **Janusz Granat**

P. Najdychor
*Wykorzystanie strumieniowych baz danych we wspomaganiu decyzji*
Degree awarded on October 2013

P. Koźmiński OKNO
*Zastosowanie sieci społecznych w telekomunikacji*
Degree awarded on October 2013

Advisor: **Jerzy Gustowski**

K. Rogalski
*Zarządzanie sterownikiem PLC za pomocą urządzenia mobilnego*
Degree awarded on March 2013

K. Szewczyk
*Programowanie zadań dla serwera OPC*
Degree awarded on October 2013

C. Łysiak
*Komunikacja PROFINET w sieci Internet*
Degree awarded on October 2013

Advisor: **Mariusz Kaleta**

H. Cieślicki
*Metody oceny wiarygodności w handlu w sieciach społecznościowych*
Degree awarded on October 2013

T. Kolbus
*Zastosowanie modelu M3 w warunkach rzeczywistego rynku energii elektrycznej*
Degree awarded on October 2013

Advisor: **Mariusz Kamola**

K. Iracki
*Estymacja macierzy ruchu w sieci IP*
Degree awarded on March 2013

Advisor: **Włodzimierz Kasprzak**

J. Popiołkiewicz OKNO
*Zastosowanie technik stenanograficznych do zabezpieczania zdjęć w dokumentach tożsamości*
Degree awarded on March 2013 (with honors)

Advisor: **Adam Kozakiewicz**

M. Szawłowski
*Wykrywanie wizualizacji: realizacja, detekcja i przeciwdziałanie*
Degree awarded on September 2013

Advisor: **Tomasz Kruk**

R. Jóźwiak
*Bezpieczne zarządzanie sesją HTTP*
Degree awarded on March 2013

Advisor: **Adam Krzemienowski**

M. Sasin
*Programowanie stochastyczne w optymalizacji transakcji rynku Forex*
Degree awarded on March 2013

M. Lubaś
*Optymalizacja portfela inwestycji z opcyjną strategią zabezpieczającą typu Colmar*
Degree awarded on October 2013

Advisor: **Bartłomiej Kubica**

G. Kozikowski
*Wycena wrażliwości opcji finansowych oparta na algorytmach automatycznego różniczkowania z wykorzystaniem technologii CUDA*
Degree awarded on April 2013

T. Borkowski
*Porównywanie testów istnienia zera układu równań w zadanym obszarze – testy Mirandy, Borsuka i Newtona*
Degree awarded on March 2013

K. Szymański
*Analiza porównawcza algorytmów rozwiązywania układów równań liniowych z przedziałowymi parametrami*
Degree awarded on June 2013

P. Dobrzycki
*Porównanie systemów klastrowych różnego typu*
Degree awarded on October 2013

P. Kozłowski OKNO
*Rozwój technologii internetowych na przykładzie AJAX w ASP.NET*
Degree awarded on October 2013

J. Tomaszkiewicz
*Porównanie różnych metod rozproszonego kończenia wykonania programu*
Degree awarded on October 2013

Advisor: **Maciej Ławryńczuk**

K. Furmańczyk
*Radialne sieci neuronowe w modelowaniu i algorytmach regulacji predykcyjnej*
Degree awarded on March 2013

P. Barszcz
*Jednowarstwowe sieci neuronowe z rozszerzeniem funkcyjnym w regulacji predykcyjnej*
Degree awarded on October 2013

Advisor: **Ewa Niewiadomska- Szynkiewicz**

M. Sierhej
*A Sim/ Java based simulator of IEEE 802.15.4 wireless sensor network*
Degree awarded on April 2013

Advisor: **Włodzimierz Ogryczak**

M. Duda
*K-sum najkrótsza ścieżka z zastosowaniem programowania liniowego*
Degree awarded on March 2013

I. Rakevich
*Sprawiedliwy rozdział zadań w wielu rundach na przykładzie obsady sędziowskiej rozgrywek*
Degree awarded on October 2013

Advisor: **Andrzej Pacut**

K. Bocian
*Tworzenie syntetycznej tęczówki na podstawie zadanego kodu*
Degree awarded on October 2013

Advisor: **Piotr Pałka**

K. Wasak
*Zastosowanie procesów biznesowych w modelowaniu protokołów interakcji dla metod handlu w systemach wieloagetowych*
Degree awarded on March 2013

M. Białek
*Modelowanie przepływu informacji handlowych w łańcuchu dostaw z wykorzystaniem modelu M3*
Degree awarded on October 2013

Advisor: **Andrzej Paszkiewicz (TK)**

M. Michałowski OKNO
*Współczesne metody ochrony serwerów pocztowych przed spamem na przykładzie rozwiązań sprzętowych oraz softwareowych*
Degree awarded on March 2013

Advisor: **Krzysztof Pieńkosz**

P. Czyż
*Algorytmy optymalizacji pakowania elementów kolistych*
Degree awarded on October 2013

Advisor: **Przemysław Rokita (II)**

M. Sobiecki
*Szablon gry komputerowej na przykładzie dwuwymiarowych gier platformowych*
Degree awarded on March 2013

Advisor: **Marcin Szlenk**

M. Pasieka
*Generowanie kodu testującego na podstawie modeli zapisanych w języku Alloy*
Degree awarded on March 2013

P. Zakrzewski
*Modelowanie programów funkcyjnych tworzonych w języku Haskell*
Degree awarded on October 2013

Advisor: **Eugeniusz Toczyłowski**

R. Karpuk
*Analiza struktur procesów bilansujących na rynkach energii elektrycznej*
Degree awarded on June 2013 (with honors)

Advisor: **Tomasz Traczyk**

K. Jackiewicz
*Integracja systemów z bazami danych w architekturze SOA*
Degree awarded on March 2013 (with honors)

T. Gidlewski
*Ontologia energetyczna*
Degree awarded on October 2013

K. Pater
*Opakowanie zasobów cyfrowych na potrzeby archiwizacji długoterminowej*
Degree awarded on October 2013 (with honors)

Advisor: **Tomasz Winiarski**

A. Skubis
*Dobór parametrów dla regulatora robota IRP-6 wykorzystującego odczyty z jednostki intercyjnej*
Degree awarded on October 2013

Advisor: **Piotr Witoński (IMIO)**

S. Pobłocki OKNO
*Porównwnie technologii JavaServer Faces (JSF) oraz Google Web Toolkit (GWT) na przykładzie systemu rezerwacji pokoi hotelowych*
Degree awarded on March 2013

## 5.4 B.Sc. Degrees

Advisor: **Piotr Arabas**

D. Latocha
*Administracja rozproszonym routerem korzystającym ze ścieżek MPLS*
Degree awarded on September 2013

E. Jaworski
*Biblioteka umożliwiająca odczyt danych ruchowych z grupy maszyn z systemem Linux*
Degree awarded on September 2013

Advisor: **Krzysztof Cabaj (II)**

M. Buda
*Implementacja integracja systemu HoneyPot dla aplikacji Webowych wraz z zaawansowanym systemem monitoringu i wstępnej analizy danych*
Degree awarded on September 2013

Advisor: **Janusz Granat**

P. Mordaszewski
*System wspomagania decyzji z opisem sytuacji decyzyjnej za pomocą modeli analitycznych*
Degree awarded on February 2013

P. Raczkowski
*Analiza wielokryterialna mechanizmów aukcyjnych na rynku przepustowości*
Degree awarded on February 2013

P. Okuła
*Wspomaganie decyzji w systemach ciągłego nadzoru pacjenta*
Degree awarded on September 2013

Advisor: **Jerzy Gustowski**

P. Wróbel
*Metody dostępu do archiwów procesowych w systemie WinCC*
Degree awarded on February 2013

M. Górska
*Zdalny dostęp do archiwum zmiennych procesowych system WinCC w oparciu o mechanizmy MS SQL Server*
Degree awarded on May 2013

P. Sosnowski
*Współpraca systemu wizualizacji procesów przemysłowych WinCC z zewnętrznymi aplikacjami systemu Windows*
Degree awarded on September 2013

Advisor: **Mariusz Kaleta**

P. Plata
*Alokacja kosztów rezerw energii elektrycznej z wykorzystaniem teorii gier kooperatywnych*
Degree awarded on February 2013

K. Soja
*Projekt i implementacja system obrotu wielotowarowego w sieci społecznościowej z wykorzystaniem robota internetowego*
Degree awarded on June 2013

D. Pogrebniak
*Projekt i implementacja środowiska do rozwiązywania problemów grafowych*
Degree awarded on September 2013

Advisor: **Mariusz Kamola**

M. Pawluczuk
*Prototypowa implementacja serwisu społecznościowego peer-to-peer na urządzenia mobilne*
Degree awarded on February 2013

M. Sikora
*Mobilny system monitorowania zawodnika na torze wyścigowym*
Degree awarded on February 2013

Ł. Fijas
*Porównanie efektywności protokołów OpenFlow i MPLS*
Degree awarded on September 2013

Advisor: **Włodzimierz Kasprzak**

K. Przerwa
*Analiza obrazu na potrzeby interfejsu człowieka z maszyną – rozpoznawanie mimiki twarzy*
Degree awarded on September 2013

Advisor: **Tomasz Kornuta**

Ł. Żmuda
*Mechanizmy przełączania zachowań w aplikacjach aktywnej wizji*
Degree awarded on February 2013

K. Kalkhoff
*Planowanie tras I nawigacja robota mobilnego*
Degree awarded on September 2013

Advisor: **Adam Kozakiewicz**

P. Cebulski
*Narzędzie do anonimizacji pakietów popularnych protokołów*
Degree awarded on February 2013

G. Bondyra
*Narzędzie wspomagające analizę zagrożeń webowych wykorzystujących JavaScript jako wektor ataku*
Degree awarded on June 2013

Advisor: **Rajmund Kożuszek (II)**

D. Krakowiak
*Realizacja techniki śledzenia promieni CPU I GPU*
Degree awarded on September 2013

Advisor: **Tomasz Jordan Kruk**

D. Durka
*Zastosowanie mechanizmu WebSocket w architekturach klient – serwer*
Degree awarded on September 2013

M. Gładki
*Wykorzystanie narzędzia Drools Planner w środowisku reguł biznesowych Drools*
Degree awarded on September 2013

Advisor: **Maciej Ławryńczuk**

K. Tkaczyk
*The on – line ticket booking software system for bus companies*
Degree awarded on October 2013

M. Szymański
*Algorytmy regulacji predykcyjnej bazującej na modelach neuronowych w przestrzeni stanu*
Degree awarded on November 2013

Ł. Woźniak
*Zastosowanie sieci neuronowych do klasyfikacji poczty elektronicznej*
Degree awarded on September 2013

Advisor: **Ewa Niewiadomska-Szynkiewicz**

W. Kaczorowski
*Algorytmy wyszukiwania grup w sieciach społecznych*
Degree awarded on July 2013

Advisor: **Andrzej Pacut**

Ł. Gajownik
*Weryfikacja podpisu odręcznego metodą off-line*
Degree awarded on February 2013

C. Guz
*Odległość, podobieństwo i niepodobieństwo obrazów na przykładzie odcisków palców*
Degree awarded on September 2013

Advisor: **Piotr Pałka**

S. Michalski
*Multi – Agent management system of electric power unbalance*
Degree awarded on June 2013

Advisor: **Krzysztof Pieńkosz**

Ł. Mętrak
*Algorytmy heurystyczne dla semi ciągłego zadania transportowego*
Degree awarded on February 2013

A. Prus
*Algorytmy szeregowania częściowo podzielnych zadań na procesorach równoległych*
Degree awarded on June 2013

P. Bielaczyc
*System wspomagania zarządzania finansami przedsiębiorstwa*
Degree awarded on June 2013

Advisor: **Grzegorz Płoszajski**

M.Góral
*Analiza podobieństw zbiorów terminów naukowo – technicznych*
Degree awarded on September 2013

Advisor: **Joanna Putz-Leszczyńska**

K. Koryciorz
*Dynamiczne marszczenie czasu (DTW) – implementacja metod skracających czas obliczeń i badanie ich wpływu na rozwiązanie*
Degree awarded on June 2013

M. Granacki
*Automatyczna identyfikacja tożsamości na podstawie biometrii chodu I geometrii ciała*
Degree awarded on June 2013

Advisor: **Paweł Radziszewski (II)**

R. Pożoga
*System detekcji robotów sieciowych w kontekście poprawy bezpieczeństwa aplikacji internetowych*
Degree awarded on February 2013

Advisor: **Andrzej Stachurski**

P. Niżyński
*Równoległe generator liczb i wektorów pseudolosowych*
Degree awarded on September 2013

A. Subko
*Optymalizacja konfiguracji stanowiska komputerowego*
Degree awarded on September 2013

Advisor: **Tomasz Starecki (ISE)**

J. Caliński
*Stepper motor driver for milling machine table movement control*
Degree awarded on June 2013

Advisor: **Marcin Szlenk**

B. Owczarek
*Transformacja diagramó1 – UML do modeli w języku Alloy*
Degree awarded on September 2013

J. Żebrowski
*Narzędzie do modelowania decyzji architektonicznych*
Degree awarded on September 2013

Advisor: **Wojciech Szynkiewicz**

P. Rabiński
*Vision based gesture – driver human – robot interface*
Degree awarded on September 2013

Advisor: **Piotr Szotkowski (TELE)**

J. Gonera
*Projekt i implementacja usługi internetowej do zarządzania zadaniami wykorzystującej interfejs Rest oraz współpracującej z nią aplikacji mobilnej*
Degree awarded on June 2013

Advisor: **Eugeniusz Toczyłowski**

D. Góralczyk
*Planowanie produkcji z uwzględnieniem dostaw w okresach zagregowanych*
Degree awarded on September 2013

J. Lewandowska
*Wpływ metody zarządzania zapasami na efektywność łańcucha dostaw*
Degree awarded on September 2013

C. Kowalczyk
*Wspomaganie decyzji inwestycyjnych na nasyconych rynkach telekomunikacyjnych*
Degree awarded on September 2013

Advisor: **Tomasz Traczyk**

A. Kurdo
*Zarządzanie kopiami zasobów w archiwum cyfrowym*
Degree awarded on February 2013 (with honors)

A. Wtykło
*Wspomaganie procesu wprowadzania zdjęć wraz z opisami do bazy danych dokumentującej zabytki*
Degree awarded on June 2013

Advisor: **Paweł Wawrzyński**

M. Rosiewicz
*Projekt i implementacja platform wspomagającej testowanie algorytmów uczenia przez wzmacnianie*
Degree awarded on February 2013Ł. Jendrzejek Zmysł równowagi robota humanoidalnego *June 2013**

P. Szynkiewicz
*Implementacja symulatora impulsowych sieci neuronowych w technologii AMD stream*
Degree awarded on February 2013

M. Gawkowski
*Efektywna implementacja uczenia przez wzmacnianie w technologii NVIDIA CUDA*
Degree awarded on September 2013

Advisor: **Tomasz Winiarski**

M. Kula
*Stanowisko do badania charakterystyki tłumaczenia manipulatora IRp – 6*
Degree awarded on June 2013

A. Sobota
*Wykorzystanie RViZ do wizualizacji i sterowania manipulatorem IRp – 6*
Degree awarded on September 2013

P. Krajewski
*Rozpoznanie układu pól kostki Rubika z wykorzystaniem aktywnej wizji*
Degree awarded on September 2013

B. Świstak
*Symulacja pojedynczego stopnia swobody robota manipulacyjnego*
Degree awarded on September 2013

# 6 Publications

## 6.1 Scientific or Technical Books

[B1] P. Tatjewski: *Metody numeryczne*. Oficyna Wydawnicza Politechniki Warszawskiej, 2013.

[B2] J. Wojciechowski and K. Pieńkosz: *Grafy i sieci*. Wydawnictwo Naukowe PWN, 2013.

[B3] A. Woźniak: *Decyzje w warunkach współzawodnictwa*. CeDeWu, 2013.

[B4] A. Zalewski: *Modelling and Evaluation of Software Architectures*, vol. 187 of *Prace Naukowe Politechniki Warszawskiej. Elektronika*. Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2013.

## 6.2 Scientific and Technical Papers in Journals

[J1] K. Daniluk: "Time synchronization in Wireless Sensor Networks", *Annals of Computer Science and Information Systems, Position Papers of the 2013 Federated Conference on Computer Science and Information Systems*, Vol. 1, pp. 83–88, 2013.

[J2] A. Hurkała and J. Hurkała: "Authentication system for websites with paid content: An overview of security and usability issues", *International Journal of Computer Science and Network Security*, vol. 13, no. 7, pp. 42–49, 2013.

[J3] M. Kamola and P. P. Arabas: "Simulation-based optimization of transportation costs in high pressure gas grid", *Computer Research Repository*, pp. 1–7, 2013.

[J4] M. Karpowicz and K. Malinowski: "Price-based coordinability in hierarchical systems with information asymmetry: a comparative analysis of nash equilibrium conditions", *Control and Cybernetics*, vol. 42, no. 1, pp. 84–110, 2013.

[J5] W. Kasprzak, W. Szynkiewicz, T. Zielińska, C. Zieliński, P. Trojanek, T. Winiarski, T. M. Kornuta, and M. Walęcki: "Wielorobotowa rekonfigurowalna forma mocująca obrabiane detale – program sterujący", *Pomiary Automatyka Robotyka*, vol. 17, no. 3, pp. 96–102, 2013.

[J6] J. Kołodziej, S. U. Khan, L. Wang, M. Kisiel-Dorohinicki, S. A. Madani, E. Niewiadomska-Szynkiewicz, A. Y. Zomaya, and C.-Z. Xu: "Security, energy, and performance-aware resource allocation mechanisms for computational grids", *Future Generation Computer Systems*, vol. 31, pp. 77–92, 2013.

[J7] T. M. Kornuta and C. Zieliński: "Robot control system design exemplified by multi-camera visual servoing", *Journal of Intelligent & Robotic Systems*, pp. 1–25, 2013.

[J8] T. M. Kornuta, T. Winiarski, and T. Bem: "Utilization of the fradia for development of robotic vision subsystems on the example of checkers' playing robot", *Machine Graphics & Vision*, vol. 20, no. 4/2011, pp. 495–520, 2013.

[J9] G. Kozikowski, B.J. Kubica: "Interval Arithmetic and Automatic Differentiation on GPU Using OpenCL", in: Applied Parallel and Scientific Computing 11th International Conference, PARA 2012/Manninen P., Öster P. (Eds.), Lecture Notes in Computer Science, vol. 7782, Springer, pp. 489-503, 2013

[J10] A. A. Krzemienowski: "Wielowymiarowa warunkowa wartość zagrożona jako miara ryzyka", *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, vol. 154, pp. 53–60, 2013.

[J11] B. J. Kubica and A. Woźniak: "Tuning the interval algorithm for seeking pareto sets of multi-criteria problems", *Lecture Notes In Computer Science*, vol. 7782, pp. 504–517, 2013.

[J12] M. Ławryńczuk: "Algorytmy regulacji predykcyjnej i optymalizacji punktu pracy procesów", *Przegląd Komunalny*, pp. 60–64, 2013.

[J13] M. Ławryńczuk: "Practical nonlinear predictive control algorithms for neural wiener models", *Journal of Process Control*, no. 23/2013, pp. 696–714, 2013.

[J14] E. Niewiadomska-Szynkiewicz, A. Sikora, P. P. Arabas, and J. Kołodziej, "Control system for reducing energy consumption in backbone computer network", *Concurrency and Computation-Practice & Experience*, vol. 25, no. 12, pp. 1738–1754, 2013.

[J15] E. Niewiadomska-Szynkiewicz, A. Sikora, P. P. Arabas, M. Kamola, M. Mincer, and J. Kołodziej: "Dynamic power management in energy-aware computer networks and data intensive computing systems", *Future Generation Computer Systems*, pp. 1–13, 2013.

[J16] E. Niewiadomska-Szynkiewicz, A. Sikora, and J. Kołodziej: "Modeling mobility in cooperative ad hoc networks", *Mobile Networks and Applications*, vol. 18, pp. 610–621, 2013.

[J17] W. Ogryczak, P. Perny, and P. Weng: "A compromise programming approach to multiobjective markov decision processes", *International Journal of Information Technology & Decision Making*, vol. 12, no. 5, pp. 1021–1053, 2013.

[J18] P. Pałka and R. O. Schoeneich: "System komunikacji wykorzystujący bezprzewodowe sieci niespójne w sytuacjach kryzysowych. communication system dedicated to crisis situation based on the concept of wireless delay and disruptive tolerant network", *Rynek Energii*, vol. 106, no. 3, pp. 9–13, 2013.

[J19] K. Pater and T. Traczyk: "Opakowanie zasobów cyfrowych na potrzeby archiwizacji długoterminowej", *Studia Informatica*, vol. 34, no. 2b, pp. 89–103, 2013.

[J20] K. Sacha and A. Ratkowski: "Transformational implementation of business processes in soa", *International Journal on Advances in Software*, vol. 6, no. 1-2, pp. 92–103, 2013.

[J21] R. O. Schoeneich and P. Pałka: "Abra: protokół rutingu dla niespójnych sieci dtn oparty na teorii aukcji", *Przegląd Telekomunikacyjny- Wiadomości Telekomunikacyjne*, vol. LXXXVI, no. 8-9/2013, pp. 956–959, 2013.

[J22] D. Seredyński, T. Winiarski, K. Banachowicz, M. Walęcki, M. Stefańczyk, and P. Majcher: "Robot mobilny o zmiennym sposobie lokomocji – konstrukcja mechaniczna i elektroniczna", *Pomiary Automatyka Robotyka*, vol. 1, pp. 162–167, 2013.

[J23] D. Seredyński and T. Winiarski: "Robot mobilny o zmiennym sposobie lokomocji – wyniki badań", *Pomiary Automatyka Robotyka*, vol. 7-8, pp. 107–11, 2013.

[J24] M. Stefańczyk, K. Banachowicz, M. Walęcki, and T. Winiarski: "3d camera and lidar utilization for mobile robot navigation", *Journal of Automation, Mobile Robotics and Intelligent Systems*, vol. 7(4), pp. 27–33, 2013.

[J25] P. Trojanek, M. Stefańczyk, and T. M. Kornuta: "Modelling of data flow in component-based robot perception systems", *Pomiary Automatyka Robotyka*, no. 2/2013, pp. 260–265, 2013.

[J26] P. Wawrzyński and A. K. Tanwani: "Autonomous reinforcement learning with experience replay", *Neural Networks*, vol. 41, pp. 156–167, 2013.

[J27] P. Wawrzyński, J. Możaryn, and J. Klimaszewski: "Robust velocity estimation for legged robot using on-board sensors data fusion", *Journal of Automation, Mobile Robotics and Intelligent Systems*, pp. 717–722, 2013.

[J28] A. Wilkowski and W. Kasprzak: "Steganographic authentication method for electronic ids", *Lecture Notes In Computer Science*, vol. 7950, pp. 726–733, 2013.

[J29] T. Winiarski and D. Seredyński: "Robot mobilny o zmiennym sposobie lokomocji – konstrukcja mechaniczna i elektroniczna", *Pomiary Automatyka Robotyka*, vol. 17, no. 5, pp. 93–99, 2013.

[J30] T. Winiarski, K. Banachowicz, and M. Stefańczyk: "Safe strategy of door opening with impedance controlled manipulator", *Journal of Automation, Mobile Robotics and Intelligent Systems*, vol. 7(4), pp. 21–26, 2013.

[J31] T. Winiarski and K. Banachowicz: "System akwizycji skorygowanej siły uogólnionej kontaktu robota manipulacyjnego z otoczeniem", *Pomiary Automatyka Robotyka*, vol. 17, no. 2, pp. 390–394, 2013.

[J32] A. Zalewski and S. Kijas: "Beyond atam: Early architecture evaluation method for large-scale distributed systems", *Journal of Systems and Software*, vol. 86, no. 3, pp. 683–697, 2013.

[J33] C. Zieliński, W. Kasprzak, T. M. Kornuta, W. Szynkiewicz, P. Trojanek, M. Walęcki, T. Winiarski, and T. Zielińska: "Control and programming of a multi-robot-based reconfigurable fixture", *Industrial Robot-An International Journal*, vol. 40, no. 4/2013, pp. 329–336, 2013.

[J34] C. Zieliński and K. Tchoń: "Interaction of robots with the environment – editorial", *Journal of Automation, Mobile Robotics and Intelligent Systems*, vol. 7, no. 4, pp. 3–4, 2013.

[J35] C. Zieliński, P. Trojanek, T. M. Kornuta, T. Winiarski, M. Walęcki, W. Kasprzak, W. Szynkiewicz, and T. Zielińska: "Wielorobotowa rekonfigurowalna forma mocująca obrabiane detale – układ sterowania", *Pomiary Automatyka Robotyka*, vol. 17, no. 2, pp. 79–85, 2013.

[J36] I. Żółtowska: "Elastic demand in uplift minimizing pricing scheme: the study of non-convex, network constrained energy market", *Rynek Energii*, no. 1/104, pp. 121–126, 2013.

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

[P1] J. P. Błaszczyk, K. Malinowski, and A. Allidina: "Optimal pump scheduling by non-linear programming for large scale water transmission system", in *Proceedings of the International Conference on Complexity, Cybernetics, and Informing Science and Engineering: CCISE 2013* (N. Callaos, G. Gill, and B. Sanchez, eds.), pp. 7–12, International Institute of Informatics and Systemics, 2013.

[P2] A. Czajka and P. Bulwan: "Biometric verification based on hand thermal images", in *Proceedings 2013 International Conference on Biometrics Fierrez* (J. Fierrez and A. Kumar, eds.), pp. 1–6, 2013.

[P3] A. Czajka: "Database of iris printouts and its application: Development of liveness detection method for iris recognition", in *Proceedings 18th International Conference on Methods and Models in Automation and Robotics* (P. Dworak, ed.), pp. 28–33, IEEE Catalog Number: CFP13MMA-CDR, 2013.

[P4] A. Czajka: "Template ageing in iris recognition", in *BIOSIGNALS 2013 - Proceedings of the International Conference on Bio-inspired Systems and Signal Processin* (S. Alvarez, J. Sole-Casals, A. L. N. Fred, and H. Gamboa, eds.), pp. 70–78, SciTePress, 2013.

[P5] J. Hurkała and A. Hurkała: "Fair optimization with advanced aggregation operators in a multicriteria facility layout problem", in *Proceedings of the Federated Conference on Computer Science and Information Systems - FedCSIS 2013* (M. Ganzha, L. A. Maciaszek, and M. Paprzycki, eds.), p. 355–362, IEEE, 2013.

[P6] M. Kaleta: "Bidding languages for continuous auctions", in *New Trends in Databases and Information Systems* (M. Pechenizkiy and M. Wojciechowski, eds.), Advances in Intelligent Systems and Computing, pp. 211–220, Springer-Verlag, 2013.

[P7] M. Kamola and P. P. Arabas: "Shortest path green routing and the importance of traffic matrix knowledge", in *2013 24th Tyrrhenian International Workshop on Digital Communications – Green ICT*, pp. 1–6, 2013.

[P8] W. Kasprzak, M. Stefańczyk, and J. Popiołkiewicz: "The print-scan problem in printed steganography of face images", in *Proceedings of the 8th International Conference on Computer Recognition Systems CORES 2013* (R. Burduk, K. Jackowski, M. Kurzyński, M. Woźniak, and A. Żołnierek, eds.), Advances in Intelligent Systems and Computing, pp. 491–500, Springer, 2013.

[P9] T. M. Kornuta and M. Żmuda: "Specification of the structure and behaviours of a robotic system able to determine object convexity", in *Proceedings 18th International Conference on Methods and Models in Automation and Robotics* (P. Dworak, ed.), pp. 350 – 355, IEEE Catalog Number: CFP13MMA-CDR, 2013.

[P10] M. Ławryńczuk: "Development of explicit neural predictive control algorithm using particle swarm optimisation", in *Artificial Intelligence and Soft Computing. Part I* (L. Rutkowski, M. Korytkowski, R. Scherer, R. Tadeusiewicz, L. A. Zadeh, and J. Zurada, eds.), Lecture Notes in Artificial Intelligence, pp. 130–139, Springer, 2013.

[P11] M. Ławryńczuk: "Nonlinear predictive control based on least squares support vector machines hammerstein models", in *Adaptive and Natural Computing Algorithms* (M. Tomassini, A. Antonioni, F. Daolio, and P. Buesser, eds.), Lecture Notes In Computer Science, pp. 246–255, Springer, 2013.

[P12] M. Marks: "Real life data acquisition in wireless sensor network localization system", in *Proceedings 27th European Conference on Modelling and. Simulation* (W. Rekdalsbakken, R. T. Bye, and H. Zhang, eds.), pp. 477–482, 2013.

[P13] P. Marusak: "Disturbance measurement utilization in the efficient mpc algorithm with fuzzy approximations of nonlinear models", in *Adaptive and Natural Computing Algorithms* (M. Tomassini, A. Antonioni, F. Daolio, and P. Buesser, eds.), Lecture Notes In Computer Science, pp. 307–316, Springer, 2013.

[P14] P. Modliński: "Auction of time as a tool for solving multiagent scheduling problems", in *New Trends in Databases and Information Systems* (M. Pechenizkiy and M. Wojciechowski, eds.), Advances in Intelligent Systems and Computing, pp. 221–230, Springer-Verlag, 2013.

[P15] E. Niewiadomska-Szynkiewicz, M. Marks, J. Jantura, M. Podbielski, and P. M. Strzelczyk: "Comparative study of massively parallel cryptalysis and cryptography on cpu-gpu cluster", in *Military Communications and Information Technology:Recent Advances in Selected Areas* (M. Amanowicz, ed.), pp. 247–261, Wydawnictwo Wojskowej Akademii Technicznej, 2013.

[P16] E. Niewiadomska-Szynkiewicz: "Energy aware communication protocols for wireless sensor networks", in *Transaction on Computational Collective Intelligence X* (N. T. Nguyen, ed.), Lecture Notes In Computer Science, pp. 135–149, Springer, 2013.

[P17] E. Niewiadomska-Szynkiewicz, A. Sikora, P. P. Arabas, M. Kamola, K. Malinowski, P. Jaskóła, and M. Marks: "Network-wide power management in computer networks", in *Energy Efficient and Green Networking (SSEEGN), 2013 22nd ITC Specialist Seminar on* (M. A. Gregory, ed.), pp. 25–30, 2013.

[P18] E. Niewiadomska-Szynkiewicz, A. Sikora, M. Mincer, and P. P. Arabas, "Simulation of energy-aware backbone networks", in *Proceedings 27th European Conference on Modelling and. Simulation* (W. Rekdalsbakken, R. T. Bye, and H. Zhang, eds.), pp. 483–489, 2013.

[P19] P. Pałka, W. Radziszewska, and Z. Nahorski: "Application of an auction algorithm in an agent-based power balancing system", in *New Trends in Databases and Information Systems* (M. Pechenizkiy and M. Wojciechowski, eds.), Advances in Intelligent Systems and Computing, pp. 231–240, Springer-Verlag, 2013.

[P20] P. Pałka and R. O. Schoeneich: "Multi-commodity trade application to the routing algorithm for the delay and disruptive tolerant networks", in *New Trends in Databases and Information Systems* (M. Pechenizkiy and M. Wojciechowski, eds.), Advances in Intelligent Systems and Computing, pp. 241–250, Springer Berlin Heidelberg, 2013.

[P21] B. Papis and P. Wawrzyński: "A platform for rapid reinforcement learning methods development and validation", in *Proceedings of the Federated Conference on Computer Science and Information Systems – FedCSIS 2013* (M. Ganzha, L. A. Maciaszek, and M. Paprzycki, eds.), pp. 129–136, IEEE, 2013.

[P22] W. Pikulski: "Praktyczne zastosowania systemów zarządzania zaufaniem", in *Monografia "Dokonania naukowe doktorantów", Nauki inżynieryjne* (M. Kuczera, ed.), pp. 1–9, 2013.

[P23] W. Pikulski and K. Sacha: "Freshness constraints in the rt framework", in *New Results in Dependability and Computer Systems. Proceedings of the 8th International Conference on Dependability and Complex Systems DepCoS-RELCOMEX* (W. Zamojski, J. Mazurkiewicz, J. Sugier, T. Walkowiak, and J. Kacprzyk, eds.), Advances in Intelligent Systems and Computing, pp. 325–334, Springer, 2013.

[P24] A. Połomski: "Fair and truthful multiagent resource allocation for conference moderation", in *Proceedings of the Federated Conference on Computer Science and Information Systems – FedCSIS 2013* (M. Ganzha, L. A. Maciaszek, and M. Paprzycki, eds.), pp. 1021 – 1027, IEEE, 2013.

[P25] M. Przyłuski: "On a constrained regression problem and its convex optimisation formulation", in *Proceedings of KICSS'2013* (A. M. Skolimowski, ed.), pp. 565–574, Progress & Business Publishers, 2013.

[P26] J. M. Putz-Leszczyńska and A. Pacut: "Universal forgery features idea: A solution for user-adjusted threshold in signature verification", in *Transactions on Computational Collective Intelligence IX* (N. T. Nguyen, ed.), Lecture Notes In Computer Science, pp. 152–172, Springer, 2013.

[P27] R. Pytlak, J. Błaszczyk, A. Karbowski, K. Krawczyk, and T. Tarnawski: "Solvers chaining in the idos server for dynamic optimization", in *The 52nd IEEE Conference on Decision and Control*, pp. 7119–7124, 2013.

[P28] A. Ratkowski: "Transformational modeling of bpmn business process in soa context", in *New Results in Dependability and Computer Systems. Proceedings of the 8th International Conference on Dependability and Complex Systems DepCoS-RELCOMEX* (W. Zamojski, J. Mazurkiewicz, J. Sugier, T. Walkowiak, and J. Kacprzyk, eds.), Advances in Intelligent Systems and Computing, pp. 335–344, Springer, 2013.

[P29] R. O. Schoeneich and P. Pałka: "System komunikacji dedykowany do sytuacji kryzysowych oparty o koncepcję bezprzewodowych sieci niespójnych", in *Zarządzanie Energia i Teleinformatyka ZET 2013 Materiały i Studia* (H. Kaproń, ed.), pp. 31–40, KAPRINT, 2013.

[P30] A. Stachurski: "Some properties of the broyden restricted class of updates with oblique projections", in *Recent Advances in Computational Optimization* (S. Fidanova, ed.), Studies in Computational Intelligence, pp. 169–182, Springer, 2013.

[P31] M. Stefańczyk, K. Bojar, and W. Kasprzak: "Utilization of depth and color information in mobile robotics", in *Proceedings of the 8th International Conference on Computer Recognition Systems CORES 2013* (R. Burduk, K. Jackowski, M. Kurzyński, M. Woźniak, and A. Żołnierek, eds.), Advances in Intelligent Systems and Computing, pp. 845–854, Springer, 2013.

[P32] P. Suszyński and P. Wawrzyński: "Learning population of spiking neural networks with perturbation of conductances", in *Proceedings of the International Joint Conference on Neural Networks 2013 Dallas* (C. Alippi, L. Bu, and D. Zhao, eds.), pp. 332–337, IEEE, 2013.

[P33] M. Szlenk: "Towards precise architectural decision models", in *New Results in Dependability and Computer Systems. Proceedings of the 8th International Conference on Dependability and Complex Systems DepCoS-RELCOMEX* (W. Zamojski, J. Mazurkiewicz, J. Sugier, T. Walkowiak, and J. Kacprzyk, eds.), Advances in Intelligent Systems and Computing, pp. 449–458, Springer, 2013.

[P34] T. Śliwiński: "Fair resource allocation in multi-commodity networks", in *New Trends in Databases and Information Systems* (M. Pechenizkiy and M. Wojciechowski, eds.), Advances in Intelligent Systems and Computing, pp. 261–269, Springer-Verlag, 2013.

[P35] P. Trojanek, T. M. Kornuta, and C. Zieliński: "Design of asynchronously stimulated robot behaviours", in *Robot Motion and Control (RoMoCo), 9th Workshop on* (K. Kozłowski, ed.), pp. 129–134, IEEE, 2013.

[P36] M. Walęcki, M. Stefańczyk, and T. M. Kornuta: "Control system of the active head of a service robot exemplified on visual servoing", in *Robot Motion and Control (RoMoCo), 9th Workshop on* (K. Kozłowski, ed.), pp. 48 – 53, IEEE, 2013.

[P37] A. Wilkowski and W. Kasprzak: "Steganographic authentication method for electronic ids", in *10th International Conference, ICIAR 2013 Proceedings* (M. Kamel and A. Campilho, eds.), Lecture Notes In Computer Science, pp. 726–733, Springer, 2013.

[P38] A. Wysocki and M. Ławryńczuk: "An investment strategy for the stock exchange using neural networks", in *Proceedings of the Federated Conference on Computer Science and Information Systems – FedCSIS 2013* (M. Ganzha, L. A. Maciaszek, and M. Paprzycki, eds.), pp. 183 – 190, IEEE, 2013.

[P39] M. Żebrowski and A. Ratkowski: "SOA system evolution differential evaluation", in *XV Krajowa Konferencja Inżynierii Oprogramowania*, pp. 1–11, 2013.

## 6.4 Reports and Other Papers

[R1] K. Banachowicz: "Protokół komunikacji sterowników osi połączonych magistralą can", tech. rep., ICCE Report, 2013.

[R2] K. Banachowicz: "Wyznaczanie położeń czujników zamontowanych na głowicy uchylno-obrotowej", tech. rep., ICCE Report, 2013.

[R3] J. Hurkała, T. Śliwiński: "Threshold accepting heuristic for fair flow optimization in wireless mesh networks", tech. rep., ICCE Report, 2013.

[R4] M. Kamola, P. P. Arabas, P. M. Jaskóła, E. Niewiadomska-Szynkiewicz, K. Malinowski, M. Karpowicz, A. Sikora, M. Mincer, and M. Marks: "Econet – energooszczędne sieci ip", *Przegląd Telekomunikacyjny–Wiadomości Telekomunikacyjne*, vol. 3/2013, pp. 1–1, 2013.

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