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 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 is supplemented by postgraduate studies in Management of Information Technology Resources and in Project Management organized by Dr. Andrzej Zalewski as well as in Engineering of Management Information Systems and Decision Support Systems organized by Dr. Tomasz Traczyk. There is a growing interest in this form of studies. The 2009/2010 edition of those courses attracted 130 participants.

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 in 2008 an Erasmus Mundus Masters Program in Robotics. 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 institute is involved in diverse research and development projects. The most significant ones are:

- **Warsaw University of Technology was successful to secure funds from the EU European Social Fund for the Program of Development of WUT. Our Institute participates in the realization of the task: Development of the 2nd level studies in Control and Robotics in WUT. Prof. Piotr Tątjewski is responsible for this task. Four faculties of WUT participate in it. It is scheduled for the years 2008-2012.**

- **In 2010 the group headed by Prof. Ewa Niewiadomska-Szynkiewicz has started the project Low Energy Consumption NETworks (ECONET) within the 7 FP EU grant ICT-2009.1.1: The Network of the Future (FP7-ICT-2009-5). The ECONET project focuses its research and development efforts on studying innovative techniques and architectural solutions to support energy efficiency in 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).**
• The Group of Robot Programming and Pattern Recognition, has continued to conduct its research within the grant obtained from the 7th Framework Program of the Commission of the European Union (NHP-2007-3.2-1). The project named Self Reconfigurable Intelligent Swarm Fixtures (SwarmItFIX) is directed at the development of a universal fixturing device that can be used by aeroengineering and car manufacturing industries. The partners of WUT in this project are DIMEC University of Genova (Italy, the coordinator), Exechon (Sweden), PIAGGO Aero Industries Spa. (Italy), ZTS-VVU Vyskumnno-vyvojovy Ustav Kosice a.s. (Slovakia), Centro Ricerche FIAT S.C.P.A. (Italy).

• In the year 2010 Prof. Andrzej Pacut lead the project entitled ’The Platform for secure implementation of biometric systems for verification and identification’. The project was the result of the 7th competition for development projects in the field of security and country’s defense, of the Ministry of Science and Higher Education. The project is coordinated by ICCE and involves also NASK, Polish Security Printing Works and University of Warsaw. It focuses on the creation of a network of collaborating biometrics laboratories.

• Prof. Eugeniusz Toczyłowski prolonged for the year 2010 an industry-sponsored research grant from the Polish Transmission System Operator, PSE-Operator S.A., for the development of new theoretical market models and algorithms to support efficient and incentive-compatible solutions in the Polish energy balancing market.

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 congratulate Prof. Andrzej Pacut for his nomination to the title of professor. I would also like to compliment Prof. Eugeniusz Toczyłowski who has been awarded the Medal of Commission of National Education, the most significant educational award at the national level. Moreover, I congratulate prof. Krzysztof Sacha who has been nominated the member of the Committee of the National Centre for Research and Development.

Cezary Zieliński
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1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2010.

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 Krzysztof Malinowski

Professors: Włodzimierz Kasprzak, Krzysztof Malinowski, Ewa Niewiadomska-Szynkiewicz, Andrzej Pacut, Cezary Zieliński

Professors, retired: Władysław Findeisen, Radosław Ładziński, Jacek Szymanowski

Reader: Adam Woźniak

Assistant Professors: Piotr Arabas, Adam Czajka, Mariusz Kamola, Andrzej Karbowski, Adam Kozakiewicz, Tomasz J. Kruk, Bartłomiej Kubica, Wojciech Szynkiewicz, Paweł Wawrzyniak, Tomasz Winiarski

Assistant: Tomasz Kornuta

Senior Lecturer: Michał Warchoł

Ph.D. Students: Marcin Chochowski (until Feb. 2010), Krzysztof Stanisław Daniluk, Andrzej Igielski, Tomasz Kornuta, Małgorzata Kudelska, Michał Kudelski (until Sept. 2010), Piotr Kwaśniewski, Michał Marks, Jacek Michalek, Łukasz Mirtecki, Bartosz Papis, Joanna Putz-Leszczyńska (until Sept. 2010), Przemysław Strzelecki, Anna Sibilińska-Mroziewicz, Piotr Trojanek, Michał Wałęcki, Artur Wilkowski

Software Engineers: Michał Wałęcki, Piotr Trojanek
Research of the division is conducted in 3 research groups:


The main area of interest is the theory and methodology of model-based predictive repetitive control and hierarchical control structures for non-linear systems under uncertainty, methods for solving continuous and discrete time optimization problems. Particular attention is given to analysis and design of control algorithms for computer networks and ad hoc networks, parallel, synchronous and asynchronous computations and computer simulation. Also, important work is concerned with development of techniques for information systems security.


Research of the group is centered on biologically inspired control and information processing, including biometrics, machine learning, uncertainty modeling, and biological modeling. Biometrics consists in using personal characteristics for identity authentication. Our research in biometrics includes pattern recognition for iris, hand-written signatures, face images, fingerprints, etc. Also, safety of biometric data storage and exchange, biometrics intelligent cards, and data encryption using biometrics are investigated. Machine learning research is focused on reinforcement learning, applied to adaptive control and multi-agent systems. Also, learning in neural networks and modeling granularity is investigated.


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 speech 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 the single and multiple articulated or mobile robots. This research aims at the creation of service 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 Piotr Tatjewski  
*Professors:* Piotr Tatjewski, Krzysztof Sacha  
*Assistant Professors:* Paweł Domański, Maciej Ławryńczuk, Piotr Marusak, Marcin Szlenk, Andrzej Zalewski  
*Assistant:* Andrzej Ratkowski  
*Senior Lecturers:* Jerzy Gustowski, Zygmunt Komor, Urszula Kręglewska  
*Senior Engineer:* Włodzimierz Macewicz  
*Ph.D. Students:* Ali Mhammed Benniran, Bartosz Chrabski, Adam Działak, Andrzej Grudzień, Szymon Kijas, Wojciech Pikulski, Andrzej Ratkowski, Piotr Sztandera, Maciej Szumski

Research of the division is conducted in 2 research groups:


Research of the group encompasses control engineering techniques, in particular industrial process control. The focus is on predictive and fuzzy 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 fuzzy systems and neural nets. 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.


The main area of interest is the development and quality evaluation of software. Topics include software processes, software analysis and design methods, and quality evaluation. 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 Eugeniusz Toczyłowski

Professors: Włodzimierz Ogryczak, Eugeniusz Toczyłowski, Wiesław Traczyk

Readers: Jerzy Paczyński, Tomasz Traczyk

Assistant Professors: Janusz Granat, Mariusz Kaleta, Adam Kremienowski, Piotr Pałka, Krzysztof Pieńkosz, Grzegorz Płoszajski, Kamil Smolira, Andrzej Stachurski, Tomasz Śliwiński, Izabela Żółtowska (on leave since November 2009)

Assistants: Przemysław Kacprzak, Bartosz Kozłowski

Senior Lecturers: Tadeusz Rogowski, Jerzy Sobczyk

Ph.D. Students: Krzysztof Bareja, Przemysław Kacprzak, Kamil Kołtyś, Michał Majdan, Paweł Markowski, Piotr Modliński, Paweł Olender, Adam Połomski, Michał Przyłuski, Piotr Rzepakowski

Research of the division is conducted in 2 research groups:


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.


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

Software for complex systems simulation

Flood Control
FC-ROS & FC-VS (Flood Control)
decision support systems for flood control in multi-reservoir 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

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
### 1.3 Research Areas

#### Complex Systems Group

**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-based weighted fair queuing), shaping, policing used
  - Monitoring and actuating block implemented 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

**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
1.3 Research Areas

Complex Systems Group

Operations scheduling using Constraint Programming

Solution of a scheduling problem in an Oil Refinery Division

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

Complex Systems Group

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
ICCE, 2010 Annual Report

1.3  Research Areas

Complex Systems Group

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 e.g., 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

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
1.3 Research Areas

Complex Systems Group

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:

\[ a \in A = [a, \bar{a}], \quad b \in B = [b, \bar{b}], \]
\[ c \in \{+, -, *, /\} \Rightarrow a \circ b \in A \circ B \]

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

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

\[ [a, \bar{a}] + [b, \bar{b}] = [a+b, \bar{a}+\bar{b}] \]
\[ [a, \bar{a}] \cdot [b, \bar{b}] = [\min\{ab, a\bar{b}, \bar{a}b, \bar{a}\bar{b}\}, \max\{ab, a\bar{b}, \bar{a}b, \bar{a}\bar{b}\}] \]

Interval (inclusion) function:

\[ f(x) = x^2 + 2x + 1 \]
\[ f(x) = x^2 + 2x + 1 \]
\[ x \in [x, x] \Rightarrow f(x) \in f(x) \]
\[ f'(x) = 2x + 2 \]
\[ f([-5, 1]) = [-9, 16] \]

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
- multicriteria optimization problems (convex and nonconvex)

Complex Systems Group

Interval computations seek the Pareto-front of nonlinear multicriteria problems

```
compute(q(); x0, e1, a0)
// L is the list of quadruples
// y, L_in, L_bound, LUnchecked,
// where L_in's are lists of qes x
y0 = q(x0);
foreach (y in L_in)
while (a quadruple in L for which
wid(y) > ey)
pop this quadruple
{y, L2, L3, L4} from L;
if (L2 != 0)
delete sets dominated by y;
end if
if (wid(y) > ey) then
bisect y;
insert the resulting sets;
end if
end while
compute
```
1.3 Research Areas

Biometrics and Machine Learning Group

Biometrics

Iris verification

- Prototype iris recognition system
  - real-time automatic iris capture
  - automatic localization of iris and occlusions
  - fast Zak-Gabor transform for calculation of the unique iris features
  - stimulated infrared reflections analysis for detection of subterfuges (printed irises)
- Eye aliveness detection
  - pupil dynamics modeling (patent pending)
  - detection of stimulated reflections from the cornea
  - frequency spectrum analysis
- Iris image permutation for replay attack prevention

Prototype iris recognition system (IRS) with aliveness detection

Iris coding

Human eye imaged in infrared light by the IRS. Automatic localization of iris sectors free from occlusions (marked in blue)

Alliveness detection

Comparison of measured (blue dots) and modeled (red line) pupil reaction to light changes enables to construct a subterfuge detection mechanism

Biometrics and Machine Learning Group

Biometrics

Handwritten signature-based identity verification

Verification of on-line signatures

- 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

Template creation improvements:

- Hidden signature – it is an “artificial” signature which minimizes mean dissimilarity between itself and the signatures from the training set.
- Universal forgery feature idea, where the global classifier is able to classify a signature as a genuine one or, as a forgery, without the actual knowledge of the signature template and its owner.

Both ideas have been successfully applied to both on and off-line verification systems and significantly improved the recognition results. Both systems were tested on publicly available databases (MOYT and SVC).
Biometrics and Machine Learning Group

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 encrypted biometric template databases

Biometrics and Machine Learning Group

Biometric authentication for secure remote access

Novel authentication protocols and techniques employing biometrics

VPN & wireless networks applications

Development of biometric capable mobile devices and workstations

Smartcards and SIM cards application for distributed template storage and processing (match-on-token)

Central template database design and management

Multiple biometrics (iris, fingerprint and others)
Biometrics and Machine Learning Group

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

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
- Linear modeling of EEG signal
- Nonlinear modeling of EEG
  - GARCH - Generalized Autoregressive Conditional Heteroskedasticity model
### Biometrics and Machine Learning Group

#### 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

---

#### Machine Learning

**Model-free on-line adaptive control based on reinforcement learning**

Typical Reinforcement Learning methods are far too slow to be used in adaptive control. Our solution is based on a combination of Actor-Critic methods and experience replay. Simulations show more than hundredfold increase of control adaptation learning speed. We tested this approach using a simulated planar model of cheetah.
1.3 Research Areas

Biometrics and Machine Learning Group

Machine Learning
Project on humanoid robots learning of physical activities

In cooperation with PLUM z o.o. company we started a project on learning in humanoid robots. The objective of the project is to design algorithms that enable the robots to learn to walk and adroitly run. The immediate result of the project would be a learning brain for a remote-controlled Bioloid.

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Biometrics and Machine Learning Group

Machine Learning
Project on learning-driven policy optimization in industrial robots

We started a project on learning in industrial robots. The objective of the project is to design a technology that enables the robot controller to optimize their movements through learning. The project is founded by grant N514237137 of Ministry of Science and Higher Education in Poland.
Biometrics and Machine Learning Group

**Machine Learning**
Ant routing with distributed geographical localization of knowledge in ad-hoc networks

- Highly dynamic environment
- We propose to connect the knowledge gathered by ant agents with locations within the network rather than with individual nodes
- Mobile nodes exchange their knowledge as they move across the network
- Routing connections defined on the locations level are much more robust to dynamic topology changes than the connections on the nodes level
- Adaptation capabilities of ants are improved, together with the overall performance of the network (Fig. right)

Distributed localization of knowledge in AntHocGeo improves the adaptation capabilities of ants (during a sudden jump and a sudden drop of the network's load level)

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Robot Programming and Pattern Recognition Group

**MRROC++ robot programming framework**

- a collection of: C++ classes, QNX or Linux processes, and a design pattern
- designed for building open modular robot control systems
- network distributed
- requires custom built axis controllers and parallel interface to a host PC within an Ethernet network

Two co-operating IRp-6 robots

---
1.3 Research Areas

Robot Programming and Pattern Recognition Group

RNT and POLYCRANK prototype robots

- **RNT robot**: high stiffness, large workspace, serial-parallel kinematic structure
  - well suited to milling and polishing tasks
- **POLYCRANK robot**: capable of very fast motions, has no joint limits, direct drive
  - well suited to palletization tasks

![RNT robot](image1)

Control systems based on MRROC++ programming framework

![POLYCRANK robot](image2)

Robot Programming and Pattern Recognition Group

Control architecture for autonomous mobile robot teams

- **Database Knowledge**
- **Mission Commands**
- **Simultaneous Localization and Mapping (SLAM)**
- **Robot Pose Global Map**
- **Cognition / Task Planning**
- **Environment Model Local Map**
- **Wireless communication WLAN, Bluetooth**
- **Information Extraction/Aggregation**
- **Sensing**
- **Path**
- **Path Execution**
- **Actuator Commands**
- **Acting**

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)
1.3 Research Areas

Robot Programming and Pattern Recognition Group

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 tactile and force sensors to avoid jamming of the cube while rotating the faces
- Capacity for using tactile and force stimulus in manipulation
- 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

Robot Programming and Pattern Recognition Group

Two-handed Service Robot Controller Capable of Solving a Rubik’s Cube Puzzle

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)
1.3 Research Areas

Robot Programming and Pattern Recognition Group

FraDIA: Framework for Digital Image Analysis

Main concepts:
- Creation of the possibility to implement, train and test image recognition algorithms offline (recording/loading movies and images)
- Utilization of created algorithms in robotic tasks: drivers for cameras, read-to-use communication mechanisms in both FraDIA and MPRRC++ frameworks

Implementation details (version 1.0):
- Framework written in C/C++, based on the OpenCV and FLTK libraries
- Four threads: image acquisition, image processing, GUI communication with the MPRRC++
- Object-oriented design: set of base abstract classes and interfaces, collection of ready to use components, utilization of multiple design patterns

Robot Programming and Pattern Recognition Group

FraDIA: Utilization in selected robotic tasks

Robot playing checkers:
- Two working modes of visual information analysis:
  - recognition of checkers board state
  - estimation of selected checker position (during visual servoing)

Haar Classifier based object grasping:
- Training of the Haar Classifier based on computer-aided object pointing in pre-recorded movies
- Utilization of Haar Classifier for real-time object grasping

Robot Solving Rubik’s Cube:
- Real-time estimation of cube position
- Identification of the cube state

Procedures for automatic camera calibration:
- Computations of location of stand-alone camera (SAC) in the global reference frame
- Computations of mounted on the gripper camera (EIH) position in relation to the robots gripper
Robot Programming and Pattern Recognition Group

FraDIA: Future development plans

Core modifications:
- Creation of complex, parallel signal-to-symbols processing stream
- Development of new component type, where results of processing and analysis will be transferred to sink
- Extraction of existing „hard-coded“ sinks (MRROC++ transceiver, recording of movies/single images to files) and their transformation to mode „flexible“ form
- Utilization of the Qt framework for the implementation of new GUI and communication between components
- Distribution of whole recognition process into multiple threads/processes

New sources:
- New image sources: fast digital camera (94 fps), virtual camera, lidar
- Possibility for utilization of non-vision sources, e.g. microphone (speech processing)

Utilization of GPU (Graphical Processing Unit):
- Utilization of GPU for fastening of multiple image processing algorithms
- Parallelization of image segmentation and its implementation on GPU

Visual servoing:
- Redesign of the communication methods with the MRROC++ structure
- Implementation of common methods related to the location of objects in the global reference frame

Robot Programming and Pattern Recognition Group

Problems of Active Sensing

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 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, which can perform actions that will facilitate the interpretation of perceptual information. This approach is known as Active Vision.

Examples of active vision behaviours:
- In the case of sensory data received from the cameras located on the active observers (mobile robots, manipulators, etc.) most obvious behavior is to change the location of camera, thus its field of view.
- Change internal camera parameters (focus length, etc.).
- Actively control the scene lightning (position of light sources or the power of their illumination).

Utilization of active vision by the Robot Cashier:
- The goal of robot cashier is to detect and identify objects located on the conveyor belt.
- Object are identified through the recognition of their barcodes.
- Thus it can be impossible to properly interpret barcodes by the analysis of images retrieved from static camera located above the conveyor, the idea is to use camera integrated with the robot gripper.
- If something similar to barcode is detected on the scene, robot moves its effector in order to reach position which will enable proper barcode identification.
Robot Programming and Pattern Recognition Group

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 expected 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](image1)
![Following an unknown contour](image2)
![Rotating a crank](image3)
![Copying drawings](image4)

Robot Programming and Pattern Recognition Group

Planning and controlling a swarm of mobile fixtures

Seventh Framework Program
Theme [NMP-2007-3.2-1]
Project: SwarmFIX
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

**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

---

Robot Programming and Pattern Recognition Group

**Text recognition in outdoor images**

Licence plate detection and text recognition (cars, containers)
1.3 Research Areas

Robot Programming and Pattern Recognition Group

Gesture recognition in digital images
- Static and dynamic poses ("letters")
- HMM modelling of pose sequences
- Examples of gestures ("words"): 

Robot Programming and Pattern Recognition Group

Speech separation and speaker identification
- Only mixtures of source signals can be acquired,
- The goal is to estimate the directions of the speakers and to estimate the original sources.

Example: two sources and two mixtures

Time delay-based detection of source directions:

A spectrogram mask for extraction of a single source
1.3 Research Areas

**Robot Programming and Pattern Recognition Group**

**Spoken sentence recognition**

- Spectral analysis
- Acoustic-phonetic features
- Word recognition
- N-gram language model
- HMM-based sentence recognition.

\[
P(w_i | w_{i-N}, w_{i-N-1}, \ldots, w_i) = \frac{C(w_{i-N}, w_{i-N+1}, \ldots, w_i)}{C(w_{i-N}, w_{i-N-1}, \ldots, w_i)}
\]

Example of a HMM for train connection dialogues:

---

**Control Engineering Group**

**Advanced control of industrial processes**

- The multilayer control structure for industrial processes
- Non-linear process modeling using fuzzy techniques and neural networks
- Fuzzy control algorithms of Takagi-Sugeno type
- Algorithms and structures of model predictive control with linear and nonlinear process models (control laws, optimization-based algorithms)
- Software for development and testing of advanced process control algorithms

*Springer, London, 2007*
Control Engineering Group

Optimization of industrial processes and large-scale systems

- Procedures for steady-state optimization of industrial processes
- Structures and algorithms for 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

Imperial College Press/ World Scientific, 2005

Control Engineering Group

REGZA - Algorithms and software environment for modeling and advanced control of industrial processes

Software Package:

- REGZASYG – programs and interface for signal processing
- REGZAMOD – programs and interface for process modeling
- REGZADMC – interface and model predictive control algorithms: linear DMC and nonlinear with fuzzy process models
- REGZAPRN – interface and model predictive control algorithms: linear GPC and nonlinear with neural network process models
1.3 Research Areas

Control Engineering Group

REGZA - Algorithms and software environment for modeling and advanced control of industrial processes
Nonlinear predictive control structures based on fuzzy and neural models
- Algorithms with successive linearization
- Algorithms with nonlinear prediction and linearization
- Algorithms with iteratively updated nonlinear prediction and linearization
- Algorithm with nonlinear optimization

Main window of REGZASYG program

Main window of REGZADMC program

Control Engineering Group

Sensors diagnostic system
Mathematical modeling and simulation of a gas turbine engine and sensors, sensors diagnostic system design based on neural networks
1.3 Research Areas

Software Engineering Group

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

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
1.3 Research Areas

Software Engineering Group

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 RT₀, RT₁, RT₂, RT³
Ø Architecture Decision Models

Operations Research and Management Systems Group

Designing of infrastructure markets under constraints
decentralized market structure

- Seller (producer)
- Exchange
- Bilateral market
- Buyer (consumer)
- Seller (broker)
- Balancing market
- Buyer (broker)
- Seller
- Real-time delivery
- Buyer

Infrastructure (resources, constraints)
➢ Object and subject market structure
➢ Market rules designing
➢ Strategic and tactical market planning
➢ Real-time operational control
➢ Market operator decisions support tools
➢ XML-based description of market
1.3 Research Areas

Operations Research and Management Systems Group

**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

**Library catalogue digitization**

- **Skew correction**
- **Binarization**
- **Noise elimination**
- **Segmentation**

- **Framing**
  - **Recognition**
  - **C.88548**
1.3 Research Areas

Operations Research and Management Systems Group

M³ Multicommodity Market Model

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

M³ is mainly (but not only) designed for

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

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

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

M³ helps markets' development by providing

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

Operations Research and Management Systems Group

Design of Multicommodity Market Model – M³

Application of M³ on the Communication Bandwidth Market

M³ model:
- may be used in information systems for market balancing in various infrastructure networks
- is a set of formal data models, which results in XML-derived information interchange specification
- may be used in a wide range of market-oriented network systems and may significantly facilitate communication, coordination and modelling procedures
1.3 Research Areas

**Optimization and Decision Support Group**

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

**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.

- Reference point
- Solution
Optimization and Decision Support Group

Application of the reference point method for land resource assessment

- 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)

Fair network design and optimization
1.4 Statistical Data

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<th>FACULTY and STAFF</th>
<th>2008</th>
<th>2009</th>
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\(FTE\) – Full Time Employment units,
+ – corrections due to persons on long-term leave of absence

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### Statistical Data

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* Classification into workstations and personal computers changes due to modification of technical standards.
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, 2010.

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


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.


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


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.


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

Wieslaw 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.


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


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.


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 573, tel. 22 234 7126
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 Control and Robotics in 2005 from Warsaw University of Technology. Since 2003 he is with Warsaw University of Technology, and since 2002 with Research and Academic Computer Network NASK. V-ce Chair of the NASK Biometric Laboratories and a member of the NASK Research Council (2006–). Voting representative of NASK in Technical Committee on Biometrics (2009–) and expert in Technical Committee No. 182 on Information Security in IT Systems (2007–) of Polish Normalization Committee (PKN). He is also a member of the IEEE (Institute of Electrical and Electronics Engineers, Inc., 2002–) and served as the Secretary of the IEEE Poland Section (2005-2009).

Interests: Biometrics, pattern recognition, systems security.

Paweł Domański  Assistant Professor

Control and Software Engineering Division, Control Engineering Group
room 571, tel. 22 234 7861
P.Domanski@ia.pw.edu.pl

M.Sc. 1991, Ph.D. 1996 from WUT.
With WUT since 1991, half time since 1997.

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, chairmen 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/~karbowks

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


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

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

Zygmunt Komor  Senior Lecturer (part-time, until March 2010)

Control and Software Engineering Division, Control Engineering Group
room 571, tel. 22 234 7861
Z.Komor@ia.pw.edu.pl

M.Sc. 1964, Ph.D. 1976 from WUT.

With WUT since 1964.

Interests: Automatic control, control instrumentation design and implementation.

Adam Kozakiewicz  Assistant Professor (part-time)

Systems Control Division, Complex Systems Group
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.

Urszula Kręglewska  Senior Lecturer

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.


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.

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 from WUT.
With WUT since 2003. Winner of “Gold chalk” (“Złota kreda”) award.

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

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

**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 572, tel. 22 234 7632  
E.Niewiadomska@ia.pw.edu.pl, www.ia.pw.edu.pl/~ens

*M.Sc. 1986, Ph.D. 1995, D.Sc. 2005 from WUT.*  
**Interests:** Large scale systems, computer simulation, computer aided control systems design, environmental systems management, distributed computations, global optimization, telecommunication systems, ad hoc networks.

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

Operations and Systems Research Division, Optimization and Decision Support Group  
room 24, tel. 22 234 6190  
W.Ogryczak@ia.pw.edu.pl, www.ia.pw.edu.pl/~wogrycza

*M.Sc. 1973, Ph.D. 1983 in Mathematics from Warsaw University, D.Sc. 1997 in Computer Science from PAN.*  
**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*

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

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


**Jerzy Paczyński**  Reader (part-time)

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

*room 26, tel. 22 234 7862*

J.Paczynski@elka.pw.edu.pl, www.ia.pw.edu.pl/~paczynski

*M.Sc. 1963 from WUT, M.Sc. in Mathematics 1973 from Warsaw University, Ph.D. 1974 from WUT.*


*Interests:* Modeling, modeling languages, transformations of formal languages — tools and applications, application of computer algebra and logic programming to systems theory and optimization.

**Piotr Pałka**  Assistant Professor (since Jan. 2010)

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

*room 554, tel. 22 234 7648*

P.Palka@ia.pw.edu.pl, http://www.ia.pw.edu.pl/~ppalka

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

With WUT since 2009.

*Interests:* Multi-agent systems, mechanism design, incentive compatibility.
Krzysztof Pieńkosz  Assistant Professor

Operations and Systems Research Division, Operations Research and Management Systems Group
room 560a, tel. 22 234 7864
K.Pienkosz@ia.pw.edu.pl

M.Sc. 1984, Ph.D. 1992 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

Operations and Systems Research Division, Operations Research and Management Systems Group
room 560a, tel. 22 234 7864
G.Ploszajski@ia.pw.edu.pl

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. Member of the Digitization Group established by the Ministry of Culture and National Heritage

Interests: Control and simulation of discrete production systems, production management, quality management, library automation, text algorithms, information retrieval.

Tadeusz Rogowski  Senior Lecturer (part-time)

Operations and Systems Research Division, Optimization and Decision Support Group
room 530, tel. 22 234 7922
T.Rogowski@ia.pw.edu.pl

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)

Control and Software Engineering Division, Software Engineering Group
room 562, tel. 22 234 7756
K.Sacha@ia.pw.edu.pl, www.ia.pw.edu.pl/~sacha


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.

**Kamil Smolira** Assistant Professor

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

room 526, tel. 22 234 7125
K.Smolira@elka.pw.edu.pl, http://www.ia.pw.edu.pl/~ksmolira

*M.Sc. 2003, Ph.D. 2009 from WUT.*

With WUT since 2009.

*Interests*: Operations research and management, decision support in energy market.

**Jerzy Sobczyk** Senior Lecturer (part-time)

Operations and Systems Research Division, Optimization and Decision Support Group

room 519, tel. 22 234 7863
J.Sobczyk@ia.pw.edu.pl, www.ia.pw.edu.pl/~jurek

*M.Sc. 1985 from WUT.*

With WUT since 1984. FEIT Network Administrator.

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

**Andrzej Stachurski** Assistant Professor

Operations and Systems Research Division, Optimization and Decision Support Group

room 25a, tel. 22 234 7640
A.Stachurski@ia.pw.edu.pl, www.ia.pw.edu.pl/~stachurs

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


*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

Control and Software Engineering Division, Software Engineering Group
room 555, tel. 22 234 7997
M.Szlenk@ia.pw.edu.pl

M.Sc. 2000, Ph.D. 2006 from WUT.
With WUT since 2005.
Interests: Software modelling and verification, formal methods in software engineering.

Wojciech Szynkiewicz  Assistant Professor

Systems Control Division, Robot Programming and Pattern Recognition Group
room 572A, tel. 22 234 3650
W.Szynkiewicz@ia.pw.edu.pl

M.Sc. 1985, Ph.D. 1996 from WUT.
Interests: Robotics, multiple robots coordination, robot sensor-based manipulation and motion planning, autonomous navigation, real-time systems.

Tomasz Śliwiński  Assistant Professor

Operations and Systems Research Division, Optimization and Decision Support Group
room 26, tel. 22 234 7862
T.Sliwinski@ia.pw.edu.pl

M.Sc. 1999, Ph.D. 2007 from WUT.
With WUT since 2004.
Interests: Discrete optimisation, operations research, decision support.

Piotr Tatjewski  Professor (Head of Division)

Control and Software Engineering Division, Control Engineering Group
room 524, tel. 22 234 7397 and 825 0995
P.Tatjewski@ia.pw.edu.pl, www.ia.pw.edu.pl/~tatjewski

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

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

---

**Eugeniusz Toczyłowski**  Professor (Head of Division)

Operations and Systems Research Division, Operations Research and Management Systems Group  
room 516, tel. 22 234 7950  
E.Toczyłowski@ia.pw.edu.pl


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

---

**Tomasz Traczyk**  Reader (Deputy Director of the Institute)

Operations and Systems Research Division, Operations Research and Management Systems Group  
room 22, tel. 22 234 7750  
T.Traczyk@ia.pw.edu.pl, www.ia.pw.edu.pl/~ttraczyk

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

With WUT since 1984.

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

---

**Michał Warchol**  Senior Lecturer, part-time

Systems Control Division, Complex Systems Group  
room 570, tel. 22 234 7665  
M.Warchol@ia.pw.edu.pl, www.ia.pw.edu.pl/~warchol

*M.Sc. 1991, Ph.D. 2002 from WUT.*

With WUT since 1991.

**Interests:** Predictive control, synthesis of control systems, symbolic calculations, operating systems.
Paweł Wawrzyński  Assistant Professor

Systems Control Division, Biometrics and Machine Learning Group
room 560, tel. 22 234 7120
P.Wawrzynski@elka.pw.edu.pl, http://staff.elka.pw.edu.pl/~pawwrzyn

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 (since February 2010)

Systems Control Division, Robot Programming and Pattern Recognition Group
room 012, tel. 22 234 7117
tmwiniarski@gmail.com, http://robotics.ia.pw.edu.pl/tomaszwiniarski

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

With WUT since 2004.

Interests: Robot control systems, artificial intelligence.

Adam Woźniak  Reader

Systems Control Division, Complex Systems Group
room 570, tel. 22 234 7665
A.Wozniak@ia.pw.edu.pl, www.ia.pw.edu.pl/~wozniak

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


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
room 555, tel. 22 234 7997
A.Zalewski@ia.pw.edu.pl

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)

Systems Control Division, Robot Programming and Pattern Recognition Group
room 518A, tel. 22 234 5102
C.Zielinski@ia.pw.edu.pl, www.ia.pw.edu.pl/~zielinski


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

Izabela Żółtowska  Assistant Professor (on leave since November 2009)

Operations and Systems Research Division, Operations Research and Management Systems Group
room 570, tel. 22 234 7648
I.Zoltowska@elka.pw.edu.pl, home.elka.pw.edu.pl/~imilenko

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

With WUT since 2005.

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

2.3 Supporting Faculty and Staff

Przemysław Kacprzak  Assistant (part-time)

Operations and Systems Research Division, Operations Research and Management Systems Group
room 526, tel. 22 234 7125
P.Kacprzak@elka.pw.edu.pl, http://home.elka.pw.edu.pl/~pkacprza

M.Sc. 2004 from WUT.

With WUT since 2009.

Interests: Operations research, energy markets.
Tomasz Kornuta  Assistant, Software Engineer (part-time)

Systems Control Division, Robot Programming and Pattern Recognition Group  
room 012, tel. 22 234 7117  
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

Bartosz Kozłowski  Assistant (part-time)

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.

Włodzimierz Macewicz  Senior Software Engineer

Control and Software Engineering Division, Software Engineering Group  
room 525, tel. 22 234 7699  
W.Macewicz@ia.pw.edu.pl

M.Sc. 1983 from WUT.  
With WUT since 1983.  
Interests: Computer networks, data bases, operating systems, programming languages, text processing.

Andrzej Ratkowski  Assistant (part-time)

Control and Software Engineering Division, Software Engineering Group  
room 555, tel. 22 234 7997  
A.Ratkowski@ia.pw.edu.pl

M.Sc. 2005 from WUT.  
With WUT since 2009.  
Interests: Software engineering, Service Oriented Architecture, performance engineering.

Piotr Trojanek  Software Engineer

Systems Control Division, Robot Programming and Pattern Recognition Group  
room 566, tel. 22 234 7649  
P.Trojanek@elka.pw.edu.pl, robotics.ia.pw.edu.pl/PiotrTrojanek

M.Sc. 2005 from WUT.  
With WUT since 2009.  
Interests: Robot programming, real-time systems.
Michał Walecki  Software Engineer (since Dec. 2010)

Systems Control Division, Robot Programming and Pattern Recognition Group
room 012, tel. 22 234 7117
M.Walecki@elka.pw.edu.pl

Msc from WUT 2010 from WUT.
With WUT since 2010.
Interests: Design of microprocessor-based control and measurement systems, automatic control

Tomasz Winiarski  Assistant (part-time, until January 2010)

Systems Control Division, Robot Programming and Pattern Recognition Group
room 012, tel. 22 234 7117
TMWiniarski@gmail.com, http://robotics.ia.pw.edu.pl/tomaszwiniarski

For short cv and interest see p. 47

2.4 Ph.D. Students

Krzysztof Bareja  Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
room 563, tel. 22 234 7124
K.Bareja@elka.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Marcin Chochowski  Ph.D. Student (until Feb. 2010)

Systems Control Division, Biometrics and Machine Learning Group
room 518a, tel. 22 234 7805
mchochow@elka.pw.edu.pl, www.ia.pw.edu.pl/~mchochow

Supervisor: Andrzej Pacut

Bartosz Chrabski  Ph.D. Student (since Oct. 2010)

Control and Software Engineering Division, Software Engineering Group
B.Chrabski@elka.pw.edu.pl

Supervisor: Krzysztof Sacha

Krzysztof Stanisław Daniluk  Ph.D. Student (since Oct. 2010)

Systems Control Division, Complex Systems Group
K.S.Daniluk@ia.pw.edu.pl

Supervisor: Ewa Niewiadomska-Szynkiewicz

Adam Działak  Ph.D. Student

Control and Software Engineering Division, Control Engineering Group
room 567, tel. 22 234 7673
A.Dzialak@ia.pw.edu.pl

Supervisor: Piotr Tatjewski
Andrzej Grudzień  Ph.D. Student

Control and Software Engineering Division, Software Engineering Group  
room 563, tel. 22 234 7124  
A.Grudzien@ia.pw.edu.pl

Supervisor: Krzysztof Sacha

Szymon Kijas  Ph.D. Student

Control and Software Engineering Division, Software Engineering Group  
room 563, tel. 22 234 7124  
S.Kijas@ia.pw.edu.pl

Supervisor: Krzysztof Sacha

Przemysław Kacprzak  Ph.D. Student

Operations and Systems Research Division, Operations Research and Management  
Systems Group  
room 526, tel. 22 234 7125  
P.Kacprzak@ia.pw.edu.pl

Supervisor: Eugeniusz Toczyłowski  
For short cv and interest see p. 48.

Kamil Kołtyś  Ph.D. Student

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

Supervisor: Eugeniusz Toczyłowski

Tomasz Kornuta  Ph.D. Student (until Oct. 2010)

Systems Control Division, Robot Programming and Pattern Recognition Group  
room 012, tel. 22 234 7117  
T.Kornuta@elka.pw.edu.pl

Supervisor: Cezary Zieliński  
For short cv and interest see p. 49.

Małgorzata Kudelska  Ph.D. Student

Systems Control Division, Biometrics and Machine Learning Group  
room 560, tel. 22 234 7120  
M.Gadomska@elka.pw.edu.pl

Supervisor: Andrzej Pacut

Michał Kudelski  Ph.D. Student (until Oct. 2010)

Systems Control Division, Biometrics and Machine Learning Group  
room 560, tel. 22 234 7120  
M.Kudelski@elka.pw.edu.pl

Supervisor: Andrzej Pacut
Robert Kuźmiuk Ph.D. Student

Operations and Systems Research Division, Operations Research and Management
Systems Group
room 526, tel. 22 234 7125
R.Kuzmiuk@ia.pw.edu.pl

Supervisor: Eugeniusz Toczyłowski

Piotr Kwaśniewski Ph.D. Student

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

Supervisor: Krzysztof Malinowski

Michał Majdan Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
room 563, tel. 22 234 7124
M.Majdan@ia.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Paweł Markowski Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
room 563, tel. 22 234 7124
P.Markowski@ia.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Michał Marks Ph.D. Student

Systems Control Division, Complex Systems Group
room 573, tel. 22 234 7126
M.Marks@ia.pw.edu.pl

Supervisor: Ewa Niewiadomska-Szynkiewicz

Jacek Michałek Ph.D. Student (until Feb. 2010)

Systems Control Division, Biometrics and Machine Learning Group
room 518a, tel. 22 234 7805
J.Michalek@ia.pw.edu.pl

Supervisor: Andrzej Pacut

Łukasz Mirtecki Ph.D. Student (until Feb. 2010)

Systems Control Division, Biometrics and Machine Learning Group
room 518a, tel. 22 234 7805
L.Mirtecki@ia.pw.edu.pl

Supervisor: Andrzej Pacut
Piotr Modliński Ph.D. Student

Operations and Systems Research Division, Operations Research and Management Systems Group
room 526, tel. 22 234 7125
P.Modlinski@ia.pw.edu.pl

Supervisor: Eugeniusz Toczyłowski

Pawel Olender Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
P.Olender@stud.elka.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Bartosz Papis Ph.D. Student

Systems Control Division, Biometrics and Machine Learning Group
B.Papis@elka.pw.edu.pl

Supervisor: Andrzej Pacut

Wojciech Pikulski Ph.D. Student (since Oct. 2010)

Control and Software Engineering Division, Software Engineering Group
W.Pikulski@ia.pw.edu.pl

Supervisor: Krzysztof Sacha

Adam Połomski Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
A.Polomski@elka.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Michał Przyłuski Ph.D. Student (since Oct. 2010)

Operations and Systems Research Division, Optimization and Decision Support Group
M.Przyluski@ia.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Joanna Putz-Leszczyńska Ph.D. Student (until Oct. 2010)

Systems Control Division, Biometrics and Machine Learning Group
room 558, tel. 22 234 7805
jputz@elka.pw.edu.pl

Supervisor: Andrzej Pacut

Andrzej Ratkowski Ph.D. Student (until Oct. 2010)

Control and Software Engineering Division, Software Engineering Group
A.Ratkowski@elka.pw.edu.pl

Supervisor: Krzysztof Sacha

For short cv and interest see p. 49.
Piotr Rzepakowski Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group
room 563, tel. 22 234 7124
P.Rzepakowski@elka.pw.edu.pl

Supervisor: Włodzimierz Ogryczak

Anna Sibilska-Mrozieńczuk Ph.D. Student

Systems Control Division, Robot Programming and Pattern Recognition Group
A.Sibilska@ia.pw.edu.pl

Supervisor: Cezary Zieliński

Przemysław Mirosław Strzelczyk Ph.D. Student

Systems Control Division, Biometrics and Machine Learning Group
room 558, tel. 22 234 7805
pstrzelc@elka.pw.edu.pl

Supervisor: Andrzej Pacut

Piotr Sztandera Ph.D. Student

Control and Software Engineering Division, Software Engineering Group
room 563, tel. 22 234 7124
P.Sztandera@ia.pw.edu.pl

Supervisor: Krzysztof Sacha

Maciej Szumski Ph.D. Student

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

Supervisor: Piotr Tatjewski

Piotr Trojank Ph.D. Student

Systems Control Division, Robot Programming and Pattern Recognition Group
room 012, tel. 22 234 7117
P.Trojank@elka.pw.edu.pl

Supervisor: Cezary Zieliński
For short cv and interest see p. 49.

Michał Walęcki Ph.D. Student

Systems Control Division, Robot Programming and Pattern Recognition Group
room 012, tel. 22 234 7117
M.Walecki@ia.pw.edu.pl

Supervisor: Cezary Zieliński
Artur Wilkowski  Ph.D. Student

Systems Control Division, Robot Programming and Pattern Recognition Group
room 563, tel. 22 234 7124
A.Wilkowski@elka.pw.edu.pl

Supervisor: Włodzimierz Kasprzak

2.5 Administrative and Technical Staff

Teresa Bortkiewicz  Manager, Finances (part-time).

room 556, tel. 22 234 6096
T.Bortkiewicz@elka.pw.edu.pl

Maria Graszka  Office support (part-time).

room 529, tel. 22 234 7865
M.Graszka@ia.pw.edu.pl

Elżbieta Matyjasik  Secretary, Main office.

room 521, tel. 22 234 7397, 22 825 0995
E.Matyjasik@ia.pw.edu.pl

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

Jolanta Niedbało  Office support (part-time).

room 529, tel. 22 234 7865
J.Niedbalo@ia.pw.edu.pl

Jadwiga Osowska  Finances specialist (part-time).

room 556, tel. 22 234 7122
J.Osowska@ia.pw.edu.pl

M.Sc. 1975 from WUT.

Agnieszka Paprocka  Finances Support.

room 556, tel. 22 234 7122
A.Paprocka@ia.pw.edu.pl

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

Ryszard Tchorz  Technical support (part-time).

room 559, tel. 22 234 7698

Alicja Trojanowska  Secretary, Student affairs.

room 22, tel. 22 234 7750
A.Trojanowska@ia.pw.edu.pl

Beata Woźniak  Manager, Administration.

room 521a, tel. 22 234 7397
B.Wozniak@ia.pw.edu.pl

M.Sc. 1993 from Warsaw University.
## 3 Teaching Activities – Academic Year 2009/2010

### 3.1 Undergraduate and Graduate Studies

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Course code</th>
<th>Hours per week</th>
<th>Class</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration of UNIX and TCP/IP</td>
<td>ASU</td>
<td>2 – 2</td>
<td>OSK, OT</td>
<td>J. Sobczyn (spring/fall)</td>
</tr>
<tr>
<td>Algorithms and Data Structures</td>
<td>AISD1</td>
<td>2 – 1</td>
<td>sem. 3</td>
<td>A. Zaletowski (spring)</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>EAI</td>
<td>2 – – –</td>
<td>ANGL, ECETC, OT</td>
<td>W. Kasprzak (spring)</td>
</tr>
<tr>
<td>Artificial Intelligence Methods</td>
<td>MSI</td>
<td>2 – 1 – PZ-P, PZ-O, PZ-SID</td>
<td>C. Zielinski (spring)</td>
<td></td>
</tr>
<tr>
<td>Basics in Automatics</td>
<td>PODA</td>
<td>2 – 1 – PTER, PSYIA, OT</td>
<td>P. Tatjewski (spring)</td>
<td></td>
</tr>
<tr>
<td>Biometric Identity Verification</td>
<td>BIT</td>
<td>2 – 1 – SIDJB, SIDJC, PP-SID</td>
<td>A. Czajka (spring)</td>
<td></td>
</tr>
<tr>
<td>Commercial Data Bases 2</td>
<td>KBD2</td>
<td>2 – 2</td>
<td>BDSI, OT</td>
<td>T. Traczyk (fall)</td>
</tr>
<tr>
<td>Computer Networks</td>
<td>ECONNE</td>
<td>2 1 1</td>
<td>ANGL, OT</td>
<td>J. Sobczyn (spring)</td>
</tr>
<tr>
<td>Computer Networks (I)</td>
<td>SKM</td>
<td>2 – 1</td>
<td>SKOR, OT</td>
<td>J. Sobczyn (spring/fall)</td>
</tr>
<tr>
<td>Control</td>
<td>ECONT</td>
<td>2 1 1</td>
<td>ANGL, OT</td>
<td>P. Domański (spring/fall)</td>
</tr>
<tr>
<td>Data Bases 2</td>
<td>BD2</td>
<td>2 – 1 – BDSI, OT</td>
<td>T. Traczyk (spring/fall)</td>
<td></td>
</tr>
<tr>
<td>Decision Support</td>
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<td>MKPWD, OT, PP-SID</td>
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<td>Decision Support Under Risk Conditions</td>
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<td>PZ-I, OT</td>
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<td>Discrete and Network Optimisation</td>
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<td>Distributed Operating Systems</td>
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<td>M. Lawrynczuk, P. Marusak (spring/fall)</td>
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<td>Event programming (I)</td>
<td>PROZ</td>
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<td>ATP, OT</td>
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<td>sem. 4</td>
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<td>Fundamentals of Operation Research</td>
<td>POBO</td>
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<td>sem. 4</td>
<td>K. Pietkoś (spring) G. Płoszajski (fall)</td>
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<td>MKPWD, OT</td>
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<td>Fundamentals of Parallel Computation</td>
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<td>SKOR, PZ-A, PZ-I</td>
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<td>Intelligent robotic systems</td>
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<td>MUS, PZ-A, PZ-SID, OT</td>
<td>C. Zielinski (fall)</td>
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<td>Introduction to Robotics</td>
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<td>Knowledge Engineering</td>
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<td>Management IT Systems</td>
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<td>Modelling and Control of Robotics</td>
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<td>2 – 1 – ANGL</td>
<td>C. Zielinski, P. Tatjewski (spring/fall)</td>
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<td>Mobile robots</td>
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<td>ANGL, ECETC, OT</td>
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<td>Numerical Methods (J)</td>
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<td>PSTER, OT</td>
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<td>ANGL, OT</td>
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<td>Course code</td>
<td>Hours per week</td>
<td>Class</td>
<td>Lecturer</td>
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<td>2 1 1 –</td>
<td>ANGL, OT</td>
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<td>ANGL, ECETC, OT</td>
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<td>OSK, OT</td>
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<td>Optimization and Decision Support</td>
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<td>PZ-A, PZ-I, OT</td>
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<td>ANGL, OT</td>
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<td>Principles of Computer Science</td>
<td>EPCOS</td>
<td>2 – – –</td>
<td>ANGL, OT</td>
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<td>Process Control</td>
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<td>SCRJC</td>
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<td>Process Management and Scheduling</td>
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<td>MKPWD, OT, MUS, PP-SID</td>
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<td>Programmable Controllers</td>
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<td>2 – 1 –</td>
<td>MUS, OT</td>
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<td>Real-time Systems</td>
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<td>2 – 2 –</td>
<td>PSTER, OT</td>
<td>K. Sacha (spring/fall)</td>
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<td>Robot Programming Methods</td>
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<td>2 – – –</td>
<td>ANGL, ECETC, OT</td>
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<td>Software Engineering</td>
<td>IOP</td>
<td>2 – 1 –</td>
<td>OSK, OT</td>
<td>K. Sacha (spring/fall)</td>
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<td>Software Specification and Design</td>
<td>SPOP</td>
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<td>OSK, PZ-SID, PZ-I, OT</td>
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<td>Synthesis of Decision Rules</td>
<td>SRD</td>
<td>2 – 2 –</td>
<td>MKPWD, MUS, OT, PP-SID</td>
<td>K. Malinowski (spring)</td>
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</table>

**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**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Level</th>
<th>Description</th>
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<tr>
<td>ANGL</td>
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<td>taught in English</td>
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<tr>
<td>ATP</td>
<td>B.Sc.</td>
<td>specialization in Programming Algorithms</td>
</tr>
<tr>
<td>BDSI</td>
<td>B.Sc.</td>
<td>specialization in Databases and Information Systems</td>
</tr>
<tr>
<td>ISO</td>
<td>B.Sc.</td>
<td>specialization in Intelligent Computation Systems</td>
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<tr>
<td>MKPWD</td>
<td>B.Sc.</td>
<td>specialization in Computer Methods of Decision Support</td>
</tr>
<tr>
<td>MUS</td>
<td>B.Sc.</td>
<td>specialization in Control Systems and Methods</td>
</tr>
<tr>
<td>OSK</td>
<td>B.Sc.</td>
<td>specialization in Computer System Programming</td>
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<tr>
<td>OT, ECETC</td>
<td>all levels</td>
<td>free electives</td>
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<tr>
<td>PSTER</td>
<td>B.Sc.</td>
<td>specialization in Control</td>
</tr>
<tr>
<td>PSYIA</td>
<td>B.Sc.</td>
<td>specialization in Computer, Networks and Systems</td>
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<tr>
<td>PP-SID</td>
<td>M.Sc., Ph.D.</td>
<td>fundamental classes, Decision and Information Systems</td>
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<td>PZ-A</td>
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<tr>
<td>PZ-I</td>
<td>M. Sc., Ph.D.</td>
<td>advanced classes, informatics</td>
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<tr>
<td>PZ-P</td>
<td>M. Sc., Ph.D.</td>
<td>advanced classes, fundamental</td>
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<td>SCRJC</td>
<td>B.Sc., M.Sc.</td>
<td>specialization in Control Systems</td>
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<td>SKOR</td>
<td>B.Sc.</td>
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</tr>
<tr>
<td>SYK</td>
<td>B.Sc.</td>
<td>specialization in Computer Systems</td>
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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, pplications of MIS and DSS (including service science and MRP). 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


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. Performance and energy efficiency at the link layer will benefit from massive use of state-of-the-art photonic and wireless techniques, but the continuous growth of data rates will lead network devices to raise their processing capacities, thus increasing their energy requirements. 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 ECONET project will focus its research and development efforts in 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 developing 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.


A step beyond flexible/reconfigurable fixtures for higher continuous adaptation of production resources with respect to production objectives and technical conditions in the knowledge-based factory is achievable today by synergic convergence of the NMP themes of flexible fixtures, parallel robots and new/smart materials with the ICT themes of robot swarms with networked embedded control. Today’s smartest adaptable fixtures have limited adjustment capability, are mostly operated manually, are usually setup off-line with the help of external measuring equipment, e.g. laser. Significant increase in effectiveness and decrease in cost may come from on-line fully actuated configuration/reconfiguration, large adaptability to different shapes and the capability to dynamically concentrate the support in the region where manufacturing is actually performed, doing that on-line and without moving/removing the part from the fixture. We are developing the new concept.
of self adaptable swarm fixtures composed of mobile agents that can freely move on a bench and reposition below the supported part behaving as a swarm. Each fixture agent is composed of a mobile platform, a parallel robot fixed to the mobile platform, an adaptable head with phase-change fluid and an adhesion arrangement, to sustain/clamp the supported part perfectly adapting to the part local geometry. A hybrid control system is adopted and each robot is treated as an autonomous agent exhibiting its own behaviours. Behaviour based translocation of the robots to destination positions is adopted to reduce planner complexity, with no need to plan exact trajectories and no significant increase in complexity when extra units are removed/added. The area of manufacturing of thin metal sheets is considered (aircrafts and automotive bodies). The project objective is to develop a swarm fixture for a large range of sheet shapes to fully replace the specialized fixtures today used.


The aim of the task is to co-ordinate programs of 2nd level (postgraduate) studies in Automation and Robotics at four faculties of WUT (Electronics and Information Technology, Electrical Engineering, Mechatronics, Power and Aeronautical Engineering). In particular, development of the common part of the program and supporting specialized programs for different faculties exploiting their expertise. The main part of the task is to support development or modernization of 26 courses at participating faculties, including purchasing certain computer equipment.


The main goal of this project is to elaborate an improved curriculum of the training and to prepare teaching materials for the courses listed in the curriculum.


The goal was to develop an algorithm for spoken sentence recognition, that could be applied in a speech-based dialogue system. The algorithm consists of three main steps: acoustic analysis, phonetic coding and symbolic sentence recognition. Two alternative classifier has been implemented and tested: an acoustic feature-based DTW (dynamic time warping) classifier and a HMM-based (Hidden Markov Model) stochastic phonetic classifier. At the acoustic analysis centered MFCC features (mel cepstral coefficients) have
been extracted, supported by other additional speech parameters, like energy distribution moments and low-pass rate in the frequency domain. Special interest was to design and test various normalization procedures in order to limit the variability of spectral images of man and women voices.


The main aims of the project are advance of the theoretical principles regarding market mechanisms projecting as well as development of the reference electricity market balancing model. The reference market model should support the safe and efficient work of the Polish electricity system both in a short and in a log timeframe. The project takes into account current state of the Polish power system and should provide solutions elastic and open enough to encompass future evolutionary development of the power system.


The project is realized by a partnership of Plum Sp. z o.o. and the ICCE. Within the project a humanoid robot is developed with 18 degrees of freedom, multiple sensors and fully functional PC onboard connected to the computer network through WiFi. This robot is to be a commercial product manufactured by Plum Sp. z o.o. and available on the market along with software developed by the ICCE. The research objective of the project is to develop learning techniques for optimization of systems that control walking, running, and other locomotive activities in humanoid robots. Those techniques include reinforcement learning with experience replay – a subject of extensive studies in the ICCE.


A set of IT projects accompanying the development of Integrated Tax Management System for the Municipality of Warsaw has been analysed in terms of dependencies existing between the projects, their projected cost, risks and quality attributes. Different technical options for each of these projects have been analysed.


The purpose of the grant obtained from the Ministry of Science and Higher Education is to 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. The grant is expected to be completed in 30 months.

The project concerns resource allocation problem in the telecommunication network. It is assumed that the network resources may be owned by many different entities and many customers are interested in obtaining some of these resources in order to realize specific telecommunication services. In such a case the resource allocation may be done through multilateral exchange between many sellers and many buyers using market mechanism. The aim of the project is to develop auction models based on the multicommodity turnover model that support efficient allocation of network resources offered for sale to services demanded by customers. Developed auction models should take into account many different requirements regarding network resources (e.g. modular capacity) and services (e.g. VPN service requirements, hop constraint). Auction models are defined as LP or MILP optimization problems that can be solved by standard optimization solvers. Decomposition methods such as aggregation and column generation technique are considered to improve the computational efficiency of proposed models. Desired properties of auction models are examined theoretically using convex optimization and game theory and through simulations.


This work focused on the control requirements for service robots, especially on the sensing and manipulative capabilities. Active sensing involves purposeful motion of the robot to obtain relevant information from the environment. Once the measurements are obtained they need to be transformed into symbolic form in the interpretation process. The other aspect of this research is two handed manipulation and multi-fingered grasping. A multi-fingered gripper was developed for that purpose. Force sensing and visual servoing were used to perform service tasks. Moreover, the Human-Machine Interface was under investigation. Both speech understanding and recognition of gestures were studied. The experiments were conducted on a two-handed robot system equipped with cameras and force sensors. The control software was based on the MRROC++ robot programming framework.


The aim of the project is to design innovative mechanisms for bandwidth trade in the market of telecommunications transport network. The mechanisms should be designed in the form of auctions and exchanges, that enhance the efficiency of resource allocation and support the development of bandwidth market toward competition. The expected results of the project will be: the analysis of the state of global research and application of bandwidth trading models; the innovative proposals for models and mechanisms for bandwidth trading; the platform for comparative analysis of specific options of research; project of the physical, operational and information architecture of the system supporting the processes of bandwidth trade.

In 2009, the detailed task was formulated as follows: "Balancing market: proposal of functional and legal solutions". This topic is a continuation of works conducted in previous years and is focused on summary and proposals of directions for balancing market evolution. It is compatible with the main goal of the project which is to investigate the possibilities for improving energetic safety of the country within the range of generating, transmission and dispatching electrical energy on market conditions. A wide range of safety issues are considered, including strategic safety pertaining to investments, long-term safety pertaining to system utilization, mid-term and short-term safety related to system operating in normal and failure states. ICCE tasks can be grouped in two streams: 1) developing multi-commodity trade mechanisms for balancing electrical energy market and cross-border capacity auctions from the point of view of system safety conditions; 2) developing open data standards for scientific researches in the area of electrical energy market mechanisms. Variants of balancing the electrical energy systems based on multi-commodity mechanism are to be developed. Preliminary open environment for experiments and benchmark data repository of market balancing mechanism are proposed.


The research is concerned with high performance computing (HPC). The general objective of the project is to develop, implement and test novel optimization methods. The designed and implemented solvers will be applied to solve real-life problems such as control of complex physical systems. Due to the complexity of the considered problems the attention is focused on parallel and distributed computation and issues associated with reduction of computer memory usage. A new data format for storing triangular and symmetric matrices is investigated. Particularly the research is addressed to: fast and minimal storage linear and nonlinear continuous optimization solvers, hierarchical methods applying various approaches to problem decomposition, deterministic and stochastic global optimization and algorithms applying interval arithmetic tools.

The project addresses theoretical investigations, computer implementation of developed numerical algorithms and simulation experiments. The expected results of the project are novel optimization algorithms and their computer implementation accompanied with theoretical and experimental investigations. Two libraries of solvers involving parallel and distributed optimization algorithms applying recursive packed formats for storing matrices were developed. The first is the library of fast and effective linear and nonlinear solvers. The second library, called EPOCS (Environment for Parallel Optimization of Complex Systems) is dedicated to complex convex and nonconvex optimization problems. The integrated software platform EPOCS provides tools for calculating local and global solutions on parallel and multi-core computers or computer clusters. It contains algorithms for local and global optimization. The graphical interface is provided to optimization problem definition and results presentation. The effectiveness of optimization algorithms were tested through numerical experiments. Both libraries are useful tools for research and education. The results of the project were described in the research papers, a book devoted to parallel computing, and presented on conferences.

This project elaborates on how to deal with multicriteria decision problems characterized by numerous and structured criteria. Appropriate identification of the preferences of the DM is a critical aspect of the optimization problem. Based on objective satisfaction levels, the approximation of preferences on the whole set of decision alternatives is possible to be constructed. Developed approach enables usage of typical Reference Point Method achievement functions based on aspiration and reservation levels as well as a novel concept of the solidarity point. The method can be used on every level of hierarchical structure criteria.


The research aims to enhance the functionality of distributed information systems by providing a standard service for managing trust. uTrust (universal Trust) project is a first step on this path. The goal of uTrust is to develop a universal and formalized approach for trust management in a wide range of distributed information systems. Basing on this approach, the practical goal of the project is to provide a universal library of trust management functions.


Development of methods of electronic communication between entities taking part in trade on infrastructural markets. Research work include architecture and protocols of data interchange, and structure of the information, as well as methods for offers searching and negotiations in the Network.

Implementation of the results of this work may stimulate a progress on infrastructural markets, particularly development of multi-commodity Internet auctions, including distributed auctions (without central managing entity), and real-time auctions. Methods worked out can be applied in many segments of infrastructural markets, e.g. in power industry, telecommunications, and other infrastructural sectors of economy. Application of based on strong theory, formalized, verified and well described methods of M3 platform may trigger qualitative changes, which improve effectiveness, transparency, and consistence of market mechanisms. It may also help new entities to have access to the market, which formerly could be impossible due to existing informational or organizational barriers. Application of the result of the work can stimulate development of new markets and services, which finally can contribute to acceleration of growth and improvement of effectiveness of given sector of economy.

The research is concerned with a business processes design method and its implementation to the environment of Service Oriented Architecture. The main concept of this method is application to designed business process number of transformations in order to gain concrete result starting from an abstract process. Another desired effect is to reach better quality of a designed process in non-functional aspects. Processes are expressed and designed in a SOA related tool – Business Process Execution Language (BPEL). Each single transformation applied to BPEL process has to improve its quality without changing its behavior. The goal of the research is to define effective method to verify behavior equivalence after the transformation has been applied. To reach this goal the BPEL process has to be translated into LOTOS language and its behavior has to be examined with algebra process formalism. Another problem is how to define set of non-changing behaviour transformations that are similar to refactorings used in software engineering and how to examine processes behavior before and after transformation. To gain consistent design method there are quality metrics calculated for BPEL design process and is proposed a decision making strategy to decide which transformation should be applied in order to reach the best version of final process.


The objective of the project is to create a methodology of movement trajectory optimization in robotic systems that would work as movements are repeated. This would correspond to a natural ability of humans to improve efficiency of their physical activities as these are repeated. The methodology has potential of significant increase of robot work efficiency, like the movement efficiency of a person is increased since he or she grabs a tennis rocket for the first time to the moment he/she becomes a tennis Olympic champion. The above methodology will be based on reinforcement learning techniques. When designed and implemented, it will be applied to optimize movements that consist solving the Rubik’s cube by a robotic system that includes two modified IRp-6 robots.


The aim of the project is to analyze and optimize ant routing algorithms for communication networks. The robustness of these algorithms to parameter changes and the adaptation process to several scenarios of load level changes will be examined. Moreover, a modeling scheme of the packet end-to-end delay distribution will be proposed. The packet delay distribution will be modeled as a mixture of statistical distributions and these models will be built in every node of the network in an on-line manner. The models will be then used to improve the ant routing algorithms. On the base of the delay models it will be possible to build a path quality indicator that will be a better representation of the packet delays than just a mean value that is used most often. The packet delay models will be also used to develop a modification of the TCP protocol, which would be more robust to packet reordering. The delay model will be used to compute the probability that a packet assumed lost by the TCP agent will still arrive and in fact has not been lost. Thank to such mechanism, it will be possible to decrease the number of needless retransmissions in a network controlled by ant routing algorithms. Moreover, we expect that using the modified TCP will extend the range of load levels under which the
ant algorithms are able to find efficient routing policies. The analysis and results of the operation of the proposed mechanisms will be presented.


The aim of the project is to introduce and analyze an innovative approach to managing the knowledge gathered by routing agents in ad-hoc networks during the learning process. Namely, the concept of distributed geographical localization of knowledge will be proposed. In the proposed approach, the knowledge gathered by ant agents in an ad-hoc network will be connected with locations in the network rather than with individual nodes. It is expected that the proposed solution will increase the robustness of the learning algorithm to dynamic topology changes in the network and improve its adaptation capabilities. The expected final result of the project is a complex adaptive routing mechanism for ad-hoc networks based on the ant algorithm with geographical localization of knowledge. The analysis of the operation of the proposed mechanism will be presented as well.


The aim of the research project are numerically effective algorithms for model-based optimizing predictive feedback control. Technique of model-based predictive control (MPC) is now a dominating technique of advanced control, having a strong influence both on the direction of development of industrial control systems as well as on research in this area. In the project, research concerning predictive feedback control algorithms acting in cooperation with on-line economic optimization of the set-points will be performed. Nonlinear process models will be considered, as the on-line economic optimization results usually in the necessity of even strong moves of the set-points, therefore the approach based on point-linear process models is not adequate. Due to a number of advantages, in the proposed algorithms nonlinear models mainly in the form of neural networks and fuzzy models (in Takagi-Sugeno structures) will be considered. Important, from practical point of view, topics of the research will be numerical effectiveness, robust stability, tolerance on faults in the control system.


Control and management of the production, distribution, exchange of goods and service processes in complex multi-agent systems, in which there are many autonomous entities, requires sophisticated models and decision-making mechanisms. These mechanisms should ensure the effective management processes in terms of information privacy, the incompatibility of individual interests, market competition and the occurrence of many conditions and constraints specific to each system. Effective implementation of overarching objectives in the game market requires that the interests of the individuals, group and global interests are harmonized. The main objective of the project is analysis, design and verification of different aspects and characteristics of the models, mechanisms and decision-making processes in complex systems. The investigation of the various aspects and applications of market mechanisms is needed. In particular, the complex, multi-stage,
long-term, multi-commodity with complex infrastructure constraints, markets is analyzed. The analyze, design and verification of complex models and mechanisms that have desirable properties, namely the harmonization of objectives of individual participants, groups, the market designer, and external stakeholders (government, supranational institutions, such as the European Union) are done. Within the project, we develop methodology for the design of efficient and incentive compatible decision-making mechanism, and analyze the basic elements of models, market mechanisms and processes to ensure efficiency and incentive compatibility.


The aim of the project is to develop and analyze optimization models of the Conditional Average with hedging and compensation. The Conditional Average (CAVG) is a new risk measure which is defined as the integral over the central part of the quantile function. The use of CAVG with hedging may improve the outcomes generated by the Conditional Value-at-Risk (CVaR), a commonly used risk measure. CVaR, as the mean within the specified portion (quantile) of the worst outcomes, is a quite pessimistic measure. Sometimes, this may lead to inferior decisions with respect to risk, since CVaR focuses only on an underperformance. It is possible to overcome this flaw by utilizing CAVG and hedging against extreme losses. A similar strategy can be used in public facility location problems, where the Kaldor-Hicks criterion is used to compensate the most distant clients for their losses. This strategy may improve economic efficiency for the society as a whole.

**[PR25]** MNiSW Grant No. O R00 0026 07: **The platform for secure implementation of biometric systems for verification and identification.** Granting period: 17.07.2009 – 16.07.2011. The project is conducted within the 7th competition for development projects in the field of security and country’s defense, of the Ministry of Science and Higher Education. Coordination: ICCE WUT. Principal investigators: NASK, Polish Security Printing Works and University of Warsaw. Principal investigator and project coordinator: Andrzej Pacut. Investigators: Włodzimierz Kasprzak, Włodzimierz Ogrzyca.

The use of biometric systems becomes an inevitable element to ensure appropriate level of security. This applies to passports, visas, some electronic transactions and in near future other documents or network identifiers. The requirements for application of biometrics apply to common documents, issued by polish authorities but by other countries’ as well. Those task are to be faced by The Ministry of Foreign Affairs, The Ministry of the Interior and Administration and The Ministry of infrastructure. This creates the demand for purchase appropriate devices, defining quality requirements for them, selection of appropriate technologies for biometric data comparison, but also defining the procedures for secure collection and verification of biometric data. Appropriate legislative procedures also need to be defined. The application of biometric techniques must fulfill many security requirements so that it improves the security instead of decreasing it. Considering the pan-European scope of those aspects the developed solutions must be harmonized with international standards, and at the same time agree with Polish legislation.

5 Degrees Awarded

5.1 Professor Degrees
Professor Andrzej Pacut has been nominated to the title of professor on December 2010.

5.2 Ph.D. Degrees

Advisor: Krzysztof Malinowski
Michał Karpowicz
Coordination in Hierarchical Systems with Rational Agents
Thesis defended on January 2010 (with honors)

Advisor: Andrzej Pacut
Łukasz Stasiak
Real time particle filtering for parallel face detection, tracking and recognition from video sequences
Thesis defended on November 2010

Michał Kudelski
Ant learning with distributed geographical localization of knowledge for adaptive routing control in ad-hoc networks
Thesis defended on December 2010

Joanna Putz-Leszczynska
Handwritten signature verification employing dynamic time warping
Thesis defended on December 2010 (with honors)

Advisor: Krzysztof Sacha
Anna Felkner
Zarządzanie zaufaniem oparte na rolach
Thesis defended on February 2010

5.3 M.Sc. Degrees

Advisor: Jarosław Chudziak (II)
P. Porębski
Jakość danych i informacji w systemach informacyjnych
Degree awarded on March 2010

Advisor: Piotr Garbat (IMIO)
M. Pomarański
Zastosowanie ekranu dotykowego w sterowaniu aplikacjami dla urządzeń mobilnych
Degree awarded on October 2010

K. Różyczki (OKNO)
System wspomagania treningu sportowego z wykorzystaniem technologii RIA
Degree awarded on March 2010 (with honors)
R. Szul (OKNO)
Opracowanie komponentu zarządzania siecią ekspertów dla dowolnego systemu CMS. Przykładowa implementacja systemu obsługi interesantów dla wybranej instytucji
Degree awarded on March 2010

Advisor: Piotr Gawrysiak (II)

G. Grochowski (OKNO)
Internetowy system obsługi zgłoszeń Helpdesk z modułem sztucznej inteligencji
Degree awarded on March 2010

Advisor: Janusz Granat

A. Balcerzak
Przetwarzanie zdarzeniowe w czasie rzeczywistym w systemach informatycznych wspomagania decyzji
Degree awarded on March 2010

P. Dębiec
Równoległe przetwarzanie dużych zbiorów danych w serwerach OLAP
Degree awarded on October 2010

A. Hurkała
Zorientowane zdarzeniowo internetowe usługi informacyjne uwzględniające preferencje użytkowników
Degree awarded on July 2010 (with honors)

J. Hurkała
System zarządzania wiedzą osobistą
Degree awarded on July 2010 (with honors)

J. Wojciechowski
Wirtualna obiektowa baza danych z automatyczną transformatą obiektowo-relacyjną
Degree awarded on March 2010 (with honors)

J. Wojewódzka (OKNO)
Human Resources Allocation Forecast
Degree awarded on October 2010

Advisor: Elżbieta Grzejszczyk (Wydział Elektryczny)

R. Kostecki (OKNO)
System CRM w odniesieniu do wybranych zagadnień e-biznesu
Degree awarded on October 2010

Advisor: Krystian Ignasiak (IRE)

J. Rybski (OKNO)
Przenośność oprogramowania na przykładzie wieloplatformowego komunikatora internetowego
Degree awarded on July 2010
Advisor: **Stanisław Jankowski (ISE)**

M. Wojcieszonek (OKNO)

*Metoda uczenia sieci neuronowych wykorzystująca teorię wrażliwości*

Degree awarded on March 2010

Advisor: **Mariusz Kamola**

P. Talipski

*System wspomagania organizacji eksperymentów dla mechanizmu podziału zasobów giełdy usług wielotowarowych*

Degree awarded on March 2010

Advisor: **Andrzej Karbowski**

K. Obalka (OKNO)

*Metody obliczeniowe oraz ich efektywność dla markowskich procesów decyzyjnych z dwoma kryteriami: wartość oczekiwania oraz semiwariancja*

Degree awarded on October 2010

Advisor: **Włodzimiez Kasprzak**

D. Bobowski

*Program do analizy zdjęć lotniczych i satelitarnych*

Degree awarded on June 2010

P. Frelek

*Symulator systemu wieloagentowego wykonującego zadania eksploracji terenu*

Degree awarded on September 2010

Advisor: **Adam Kozakiewicz**

M. Kostecki (OKNO)

*Rozproszone sieci neuronowe w środowisku gridowym*

Degree awarded on October 2010

Advisor: **Bartłomiej Kubica**

Ł. Gajewski (OKNO)

*Porównanie narzędzi do tworzenia aplikacji graficznych na stronach internetowych na przykładzie implementacji gry w oparciu o platformy adobe flash i Microsoft Silverlight*

Degree awarded on July 2010

T. Zupka

*Implementacja biblioteki do obliczeń symbolicznych na wielomianach, w tym liczenie baz Gröbnera*

Degree awarded on September 2010

Advisor: **Sławomir Kula (TELE)**

K. Nowak (OKNO)

*Technologia 3G – ogólnodostępna alternatywa dla obecnie stosowanych rozwiązań w domowych i firmowych sieciach LAN*

Degree awarded on March 2010
Advisor: Julian Myrcha (II)
M. Gregorczyk
JavaFx jako innowacyjne rozwiązanie RIA
Degree awarded on April 2010

Advisor: Ewa Niewiadomska-Szynkiewicz
D. Piotrowski
Środowisko do badań porównawczych mechanizmów aukcyjnych
Degree awarded on November 2010

Advisor: Włodzimierz Ogryczak
K. Dudyński
Metoda punktu odniesienia z agregacją WOWA
Degree awarded on October 2010
J. Skuratowicz
Wielokryterialna optymalizacja mapy fluencji
Degree awarded on April 2010
K. Wiktowski
Zarządzanie reputacją w sieciach P2P: analiza wybranych algorytmów
Degree awarded on October 2010

Advisor: Krzysztof Pieńkosz
T. Barański
Szeregowanie zadań z częściową podzielnością na procesorach równoległych
Degree awarded on March 2010
J. Gaworzewski (OKNO)
Problem optymalizacji rozkroju tektury w procesie produkcji opakowań
Degree awarded on October 2010

Advisor: Grzegorz Płoszański
M. Gawałko
Wspomaganie jednolitej klasyfikacji tematycznej preprintów pochodzących z różnych repozytoriów
Degree awarded on March 2010

Advisor: Piotr Salata (II)
T. Śломski
Music Mining: a music player utilizing clustering algorithm and music analysis
Degree awarded on March 2010

Advisor: Andrzej Stachurski
K. Dziąg
Algorytmy ewolucyjne w wieloetapowym zadaniu transportowym
Degree awarded on July 2010
K. Sokołowska  
*Selekcja cech w zadaniach klasyfikacji obiektów metodą SVM*  
Degree awarded on March 2010 (with honors) 

K. Wnuk  
*Korelacja danych w problemach budowy optymalnego portfela i współzależności giełdy i gospodarki*  
Degree awarded on October 2010  

Advisor: **Wojciech Szynkiewicz**  

K. Czajkowski  
*System planowania i realizacji chwytów za pomocą roboczych pięk*  
Degree awarded on September 2010  

M. Gaik  
*Budowanie trójwymiarowej mapy otoczenia na podstawi danych z kamery i dalmierza laserowego*  
Degree awarded on September 2010  

Advisor: **Tomasz Śliwiński**  

S. Biskup  
*System wspomagania decyzji w konstruowaniu portfela inwestycji*  
Degree awarded on May 2010  

Advisor: **Eugeniusz Toczyłowski**  

K. Chodnicki  
*Uczenie się agentów w wieloagentowej platformie wymiany towarowej w sieciach teleinformatycz- 
nych*  
Degree awarded on October 2010  

Advisor: **Paweł Tomaszewicz (TELE)**  

M. Kucharczyk  
*Sprzętowe wspomaganie trasowania pakietów IPv6*  
Degree awarded on October 2010  

W. Wydrzyński  
*Sprzętowe wspomaganie trasowania pakietów IPv6*  
Degree awarded on October 2010  

Advisor: **Tomasz Traczyk**  

M. Lechman  
*Zastosowanie języka XVCL do budowy depozytorium diagramów klas*  
Degree awarded on April 2010 (with honors))  

Advisor: **Wiesław Traczyk**  

P. Rozenbajgier  
*Rozproszony system ekspercki z rozmytymi wartościami*  
Degree awarded on July 2010
Advisor: **Tomasz Winek** *(Wydział Elektryczny)*

K. Wiśniewski (OKNO)

*Zastosowanie osadzonych komunikatów z wykorzystaniem protokołu SIP przy budowie portali internetowych*

Degree awarded on March 2010

Advisor: **Tomasz Winiarski**

J. Kuryło

*Interaktywne programowanie robotów przy pomocy bezprzewodowego interfejsu sterującego*

Degree awarded on October 2010

Advisor: **Piotr Witoński** *(IMIO)*

Ł. Durka (OKNO)

*Wydajne przeszukiwanie zasobów dyskowych*

Degree awarded on October 2010

M. Szewczykowski (OKNO)

*Projekt i wykonanie oprogramowania do prezentacji, przetwarzania i analizy danych z radarów meteorologicznych*

Degree awarded on September 2010

Advisor: **Andrzej Zalewski**

K. Góral

*Analiza choreografii procesów biznesowych BPEL*

Degree awarded on March 2010 (with honors)

P. Markiewicz

*Modelowanie interakcji pomiędzy komponentami w architekturze sterowanej zdarzeniami (EDA) w oparciu o UML*

Degree awarded on March 2010

A. Wymysłowska

*Generowanie kodu dla środowisk integracyjnych ze specyfikacji w języku UML*

Degree awarded on July 2010

Advisor: **Izabela Żółtowska**

M. Wojtyniak

*Planowanie rozkładów jazdy pociągów poprzez aukcję w standardowym M3*

Degree awarded on March 2010

5.4 **B.Sc. Degrees**

Advisor: **Piotr Arabas**

W. Gruszczyński

*Narządzia wspomagające proces redukcji odejść użytkowników z sieci telekomunikacyjnej*

Degree awarded on February 2010
Advisor: **Andrzej Ciemski (II)**

A. Bielasty

*Zastosowanie technologii JEE i Hibernate do budowy nowoczesnego muzycznego sklepu internetowego*

Degree awarded on February 2010

R. Osiński

*Zarządzanie transakcjami z użyciem monitora transakcji na przykładzie banku*

Degree awarded on February 2010

Advisor: **Adam Czajka**

A. Bielawski

*Test żywotności oka z wykorzystaniem własności absorpcyjnych tęczówki*

Degree awarded on September 2010

W. Gutfeter

*Lokalizacja tęczówki metodą aktywnych konturów*

Degree awarded on September 2010

K. Piech

*Biometryczna karta elektroniczna*

Degree awarded on September 2010

M. Tym-Czarnocki

*Kompaktowe kodowanie podpisu odręcznego*

Degree awarded on July 2010

Advisor: **Paweł Domański**

S. Stocki

*Time-series prediction*

Degree awarded on September 2010 (with honors)

M. Więclawski

*Making computations with a graphic card: CUDA technology in time series prediction*

Degree awarded on September 2010

Advisor: **Janusz Granat**

A. Kostrzewa

*Wykrywanie anomalii w zdalnym monitoringu pacjentów*

Degree awarded on October 2010 (with honors)

Advisor: **Antoni Grzanka (ISE)**

T. Kuśmierczyk

*Deskryptory punktów w analizie morfologicznej obrazów trójwymiarowych twarzy*

Degree awarded on September 2010

Advisor: **Jerzy Gustowski**

P. Korczak

*System zarządzania suszarnią w procesie produkcji kostki brukowej*

Degree awarded on September 2010
Advisor: Mariusz Kaleta

T. Kolbus
Wspomaganie obróbki dokumentów M3-XML w systemie z graficznym interfejsem użytkownika
Degree awarded on September 2010

Advisor: Mariusz Kamola

P. Jabłoński
Porównanie metod autoryzacji Port-knocking i Single Packet Authorization pod względem bezpieczeństwa i praktycznego wykorzystania do zdalnego wykonywania operacji na serwerze z zamkniętymi portami
Degree awarded on March 2010

Advisor: Włodzimierz Kasprzak

P. Suszyński
Rozpoznawanie słów mówionych z wykorzystaniem ukrytych modeli Markowa
Degree awarded on February 2010

Advisor: Tomasz Kornuta

M. Pruchniak
Wykorzystanie GPU w algorytmach przetwarzania obrazów
Degree awarded on June 2010

Advisor: Adam Kozakiewicz

J. Gębala
Narzędzia do analizy zjawiska Fast-flux w DNS
Degree awarded on February 2010

Advisor: Adam Krzemienowski

M. Sasin
Optymalizacja portfela opcji z warunkową wartością zagrożoną jako miarę ryzyka
Degree awarded on October 2010

M. Szewczyk
Symulator gry rynkowej
Degree awarded on October 2010

Advisor: Maciej Ławryńczuk

P. Górecki
Sieci neuronowe do optymalizacji kwadratowej
Degree awarded on July 2010

P. Kuźma
Integracja możliwości obliczeniowych środowiska MATLAB z Microsoft Visual Studio: uczenie radialnych sieci neuronowych
Degree awarded on September 2010
P. Nosalski
*Algorytmy regulacji predykcjnej z modelami w przestrzeni stanów*
Degree awarded on July 2010

Advisor: **Piotr Marusak**

S. Swianiewicz
*Rozmyte sterowanie predykcjne reaktora chemicznego w warunkach ograniczeń - implementacja i badania symulacyjne*
Degree awarded on July 2010

Advisor: **Ewa Niewiadomska-Szynkiewicz**

P. Kania
*Algorytmy lokalizacji w sieciach mobilnych ad hoc*
Degree awarded on September 2010

P. Woliszczak
*System informatyczny do badania mechanizmów aukcyjnych*
Degree awarded on February 2010

Advisor: **Tomasz Owczarek (ISE)**

M. Zawislak
*Monitoring mobile networks using mobile terminal*
Degree awarded on February 2010

Advisor: **Piotr Pałka**

M. Calka
*Szkielet symulatora wieloagentowej platformy wymiany wielotowarowej*
Degree awarded on September 2010

Advisor: **Krzysztof Pieńkosz**

M. Bialobrzeski
*Modele i algorytmy alokacji przepustowości dla wirtualnych sieci prywatnych*
Degree awarded on September 2010

A. Chabowska
*Metody i algorytmy pakowania elementów podzielnych*
Degree awarded on September 2010

P. Milewski
*Przybliżone metody rozwiązywania semi-ciągłego problemu transportowego*
Degree awarded on July 2010

Advisor: **Krzysztof Sacha**

Ł. Ciechomski
*Monitorowanie przepływów biznesowych na serwerach integracyjnych platformy WebMethods*
Degree awarded on February 2010
M. Lusa
*Porównanie technologii Java Enterprise Edition 5 i .NET 3.5*
Degree awarded on July 2010

K. Wójcik
*Technologie warstwy prezentacji*
Degree awarded on September 2010

Advisor: **Andrzej Stachurski**

Ł. Lenda
*Rozproszony algorytm podziału i oszacowań do rozwiązywania kwadratowego zadania przedziału*
Degree awarded on October 2010

J. Tyszewski
*Comparing different criss-cross piroting algorithms in linear programming*
Degree awarded on July 2010

B. Wiecha
*Opracowanie aplikacji wspomagającej zarządzanie pakietem AMPL w systemie Windows XP*
Degree awarded on October 2010

Advisor: **Wojciech Szyndlewicz**

K. Rogala
*Planowanie i koordynacja działań zespołu robotów na przykładzie zadania gry drużyny robotów w piłkę nożną*
Degree awarded on February 2010

K. Trzciński
*Synteza chwytu precyzyjnego dla chwytaka trójpalczastego*
Degree awarded on September 2010

Advisor: **Eugeniusz Toczyłowski**

Ł. Drążek
*System wspomagania zarządzania łańcuchem dostaw w warunkach rynkowej konkurencji przy jednostopniowej produkcji*
Degree awarded on February 2010

K. Sędrowicz
*Wspomaganie decyzji operatorów aukcji wielotowarowych w energetyce*
Degree awarded on February 2010

J. Skorupiński
*Wieloagentowy system komputerowy wspomagający wielokryterialną analizę w problemie producenta i klientów*
Degree awarded on July 2010

Advisor: **Paweł Wawrzyński**

K. Bąk
*Symulator dynamiki złożonych układów fizycznych*
Degree awarded on February 2010
K. Boczkal
*Automatyczny dobór parametru kroki dla uczącej się on-line sieci neuronowej*
Degree awarded on September 2010

T. Niewiarowski
*Implementacja interfejsu bezprzewodowego w robocie typu BioIoid*
Degree awarded on June 2010

Advisor: **Tomasz Winiarski**

J. Stocka
*Graficzny edytor automatu specyfikującego zadanie robotyczne zapisane w języku XML*
Degree awarded on June 2010

K. Tarkowski
*Mikrokomputerowy układ z interfejsem Eth. do akwizycji danych z czujnika sił i momentów sił*
Degree awarded on November 2010

Advisor: **Adam Woźniak**

P. Majka
*Praktyczne algorytmy sprawiedliwego podziału*
Degree awarded on February 2010

M. Świderski
*Modelowanie sytuacji decyzyjnej wielu agentów o niezgodnych interesach*
Degree awarded on September 2010

A. Zalewski
*Narzędzie z graficznym interfejsem użytkownika do optymalizacji gradientowej wykorzystujący pakiet do automatycznego różniczkowania*
Degree awarded on March 2010

Advisor: **Andrzej Zalewski**

R. Pojda
*Zastosowanie standardu COBIT w audycie rozwiązań integracyjnych*
Degree awarded on February 2010

M. Romanowski
*Narzędzie do modelowania decyzji architektonicznych w procesie konstrukcji systemów IT*
Degree awarded on September 2010

Advisor: **Cezary Zieliński**

M. Boryń
*Implementacja serwomechanizmów wizyjnych w systemie MRROC++*
Degree awarded on September 2010

R. Tulwin
*Trajectory generation in MRROC++ applications*
Degree awarded on February 2010
6 Publications

6.1 Monographs


6.2 Chapters in Scientific or Technical Books


6.3 Scientific and Technical Papers in Journals


6.3 Scientific and Technical Papers in Journals


6.3 Scientific and Technical Papers in Journals


6.4 Scientific and Technical Papers in Conference Proceedings

6.5 Reports and Other Papers


6.5 Reports and Other Papers


